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Pours Iron on Second Floor

Molds Are Made and All the Iron Required Is Melted, Poured and Shaken Out on the Upper Floor—Castings Are Cleaned and Shipped on the Lower Floor

BY E. C. BOEHRINGER

VENTILATION so balanced that in summer the men on the floors are freshened by draughts 6 to 8 degrees below the torrid temperature outside and in winter at 20 below zero not a wisp of steam rises, sunlight that is filtered as it floods in and hence casts no shadows, a monoral haulage system that eliminates all trucking on the main foundry floor—these features in themselves are sufficient to attract favorable attention to the foundry of the Tri-Cities Malleable Castings Co. at East Moline, Ill., but it is the 2-story layout and construction of the foundry that stamps it as unique.

The Tri-Cities plant is 120 feet wide 395 feet long. On the second floor are the molding floors, the furnace and the shakeout equipment. Through hatchways in the floor the castings are lowered to the first floor to be cleaned annealed, finished and shipped. Were the Tri-Cities plant laid out in the orthodox, straight-line fashion it would require a structure twice as long. The effect is that of folding underneath the main foundry floor the length normally required for the operations that follow the shakeout. The result is a compact plant, distinct economy in the first cost of construction and the saving of many feet of handling on each casting.

Automobile, agricultural implement and railroad castings in about equal proportions comprise the output of the Tri-Cities foundry. The plant, designed and built by George S. Mills, Toledo, O., for

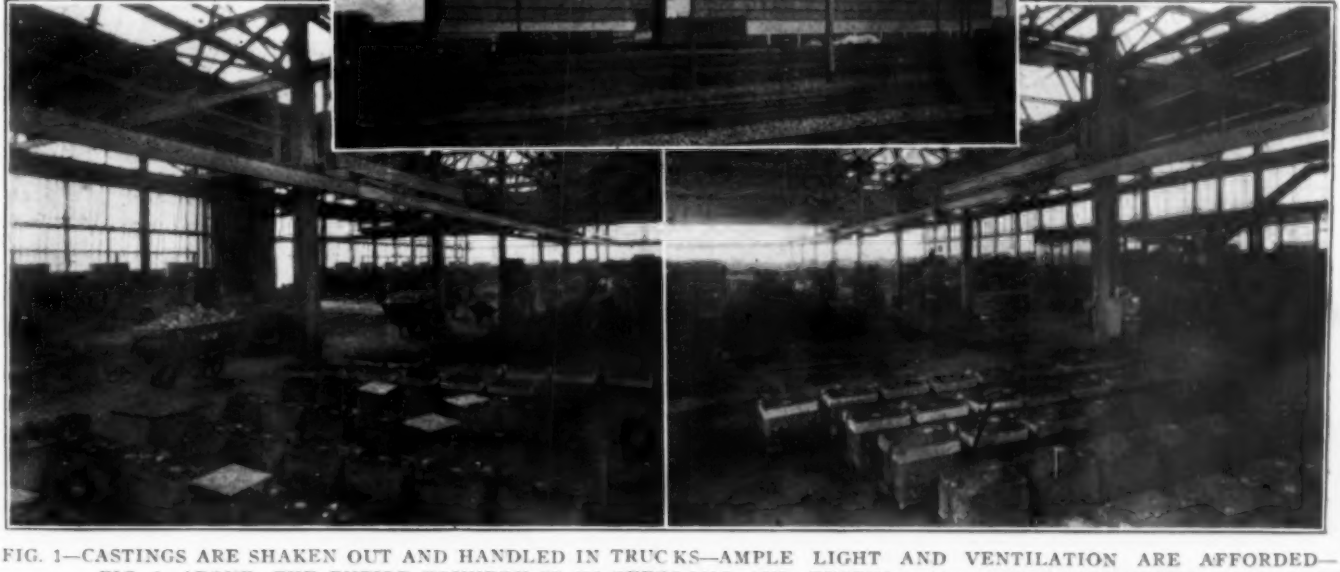


FIG. 1—CASTINGS ARE SHAKEN OUT AND HANDLED IN TRUCKS—AMPLE LIGHT AND VENTILATION ARE AFFORDED—FIG. 2—ABOVE—THE ENTIRE FOUNDRY IS 395 FEET LONG AND EXTENDS ALONGSIDE THE RAILROAD

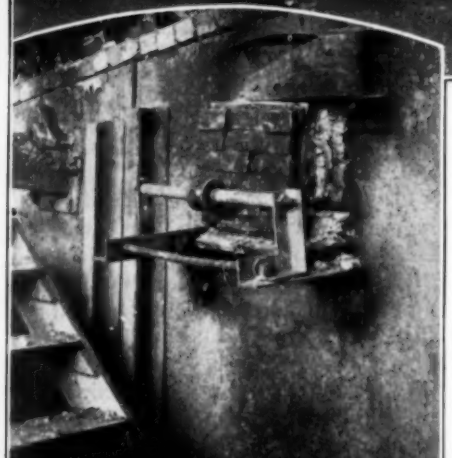


FIG. 3—DETAIL OF THE AIR FURNACE SHOWING TAP HOLE AND SKIMMING PORT. FIG. 4—LEFT SLAG SKIMMED FROM THE METAL FALLS DIRECTLY THROUGH TO THE FLOOR BELOW

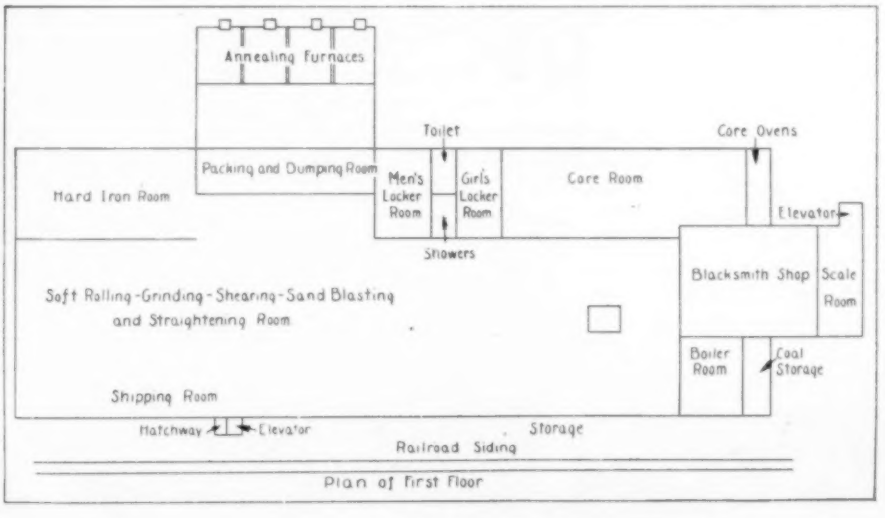
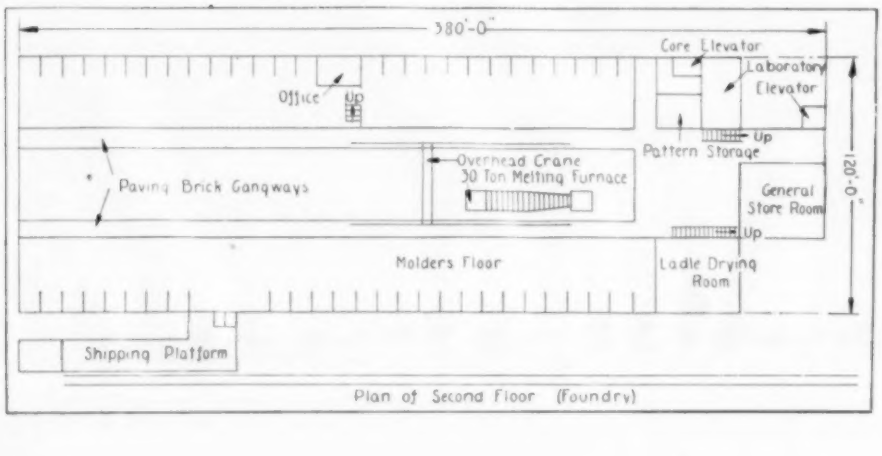


FIG. 5—BELOW—PLAN VIEW OF THE SECOND FLOOR SHOWING THE POSITION OF FURNACE FIG. 6—RIGHT—CORE ROOM AND FINISHING DEPARTMENTS ARE ON THE GROUND FLOOR



the Moline Plow Co. when that company was controlled by the Willys-Overland interests, was taken over by the present owners on June 15, 1923, and the first heat was taken off on Aug. 29, 1923. The roof, the general design and construction are mute witnesses to lavish expenditure prompted by the flush days of the war period. Originally laid out for a gray iron foundry, only 6 test heats were poured, and the cupola was supplanted by a malleable furnace.

The monorail haulage system is so interwoven in the operations of the foundry that it forms the natural approach to an understanding of the layout. It operates on 10-inch I-beams supported by the roof columns and encircles the entire main foundry floor.

As cores are removed from the ovens on the first floor they are loaded upon

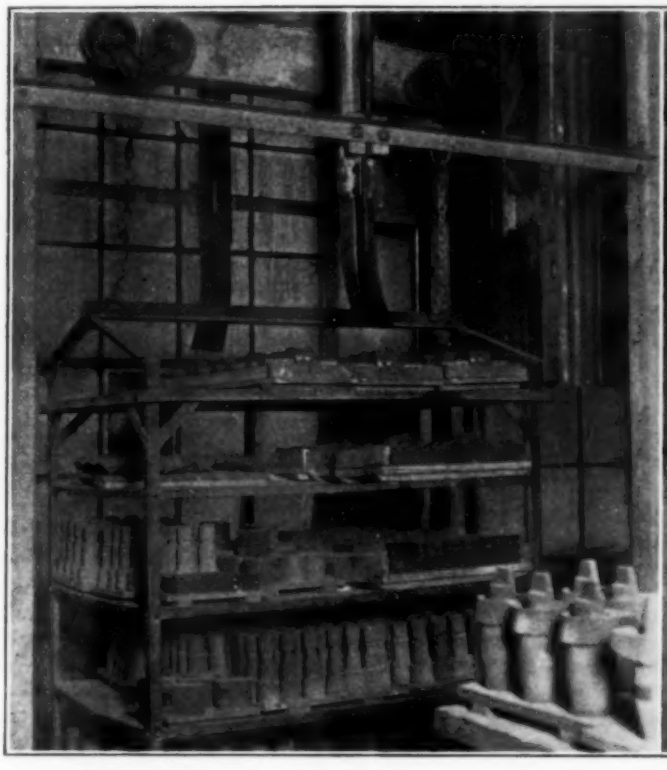


FIG. 7—THE 5-DECK CORE CARRIAGE LOADED WITH CORES IS TAKEN ON AN ELEVATOR FROM THE FIRST TO THE SECOND FLOOR FIG. 8—AFTER THE CASTINGS ARE SHAKEN OUT THEY ARE LOADED IN CANS AND LOWERED THROUGH AN OPENING IN THE SECOND FLOOR TO THE GROUND FLOOR WHERE THEY ARE PACKED AND ANNEALED

a 5-deck carriage which is elevated to the second floor and then switched over to the monorail tracks where the cores are delivered to the molders' benches. Sand from the storage piles at the west end of the second floor is hauled to the molding floors in steel barrels, 18 inches diameter by 30 inches deep. Molten metal is conveyed on this monorail in 1000 pound bull ladles. After the castings have been shaken out they are loaded into steel barrels, pushed to a hatchway at the west end of the second floor and lowered by a gravity winch through the 28-inch aperture in the floor to the cleaning room below. Sprue is loaded into 1-ton charging boxes at the side of the furnace. Switches are provided so that empty and loaded ladles or barrels do not dispute the right-of-way. Laborers make the round trip from the shakeout to the hatchway and back in 1 minute. On an average 50 seconds are required to lower a barrel of 400 to 500 pounds of castings to the first floor. One man is able to handle all the castings from one heat from the hatchway.

The building extends from east to west and in this direction the work flows. A siding from the tracks of the Chicago, Rock Island & Pacific, Chicago, Milwaukee & St. Paul and Chicago, Burlington & Quincy railroads nearby delivers material at the easterly end. Unloading is somewhat simplified by reason of the first floor being about 6 feet below grade. Scrap pig iron, core sand, coal and coke are hauled by barrows and trucks into the building and weighed. An elevator conveys the charges for the furnace to the second floor where they are trucked 120 feet to the furnace. Core sand and oil are wheeled into the core room which occupies the northeast corner of the first floor.

FIG. 9—THE CORE ROOM OCCUPIES ONE CORNER OF THE GROUND FLOOR—NOTE THE ELEVATOR AT THE LEFT FIG. 10—CASTINGS ARE PACKED, ANNEALED AND THEN RETURNED TO THE PACKING ROOM BEFORE THEY ARE DUMPED AND LOADED FOR CLEANING

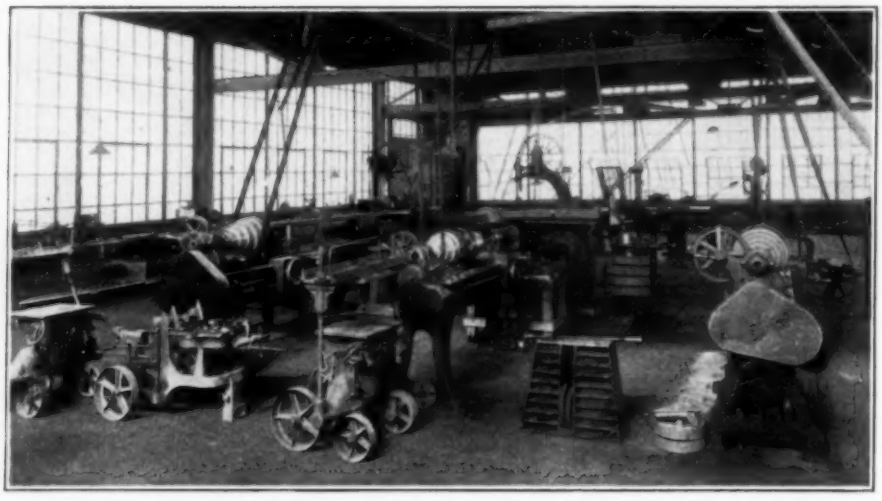


FIG. 11—A COMPLETELY EQUIPPED METAL AND WOOD PATTERN SHOP IS PROVIDED IN A WING CONNECTED AT THE EAST END WITH THE MAIN BUILDING

The coremakers deliver their finished work on racks in front of a battery of 12 ovens fired with coke. These ovens were made by Young Brothers Co., Detroit. Each compartment is provided with a stack and an exhaust motor driven fan which draws the moisture out of the oven in the early stages of the baking process. Each oven also is equipped with a pyrometer through which the temperature is closely controlled. After the cores are baked the loaded carriages are taken to the second floor and conveyed to any point on the molding floor where the cores may be required. The core sand first is mixed in a muller type mixer made by the National Engineering Co., Chicago and afterward passed through a gyratory riddle made by the Great Western Manufacturing Co. Leavenworth, Kansas.

Floors for 90 molders are equipped with power squeezer machines on the two outer bays and approximately half the center bay of the foundry. The other half of the center bay is occupied by the furnace and melting equipment. The castings made are of the usual type demanded by the implement, automobile and railroad interests and the molding methods employed present no outstanding features. Steel bands replace jackets on molds. All the molds are poured on the floor. Six inches of clay on a concrete base form the molding floor, while the gangways are of brick.

The placing of the coal-fired furnace, on the second floor makes for great economy in the handling of slag and ashes. Through a chute in the concrete floor the slag drops from the skimming door directly into trucks on the first floor below, and is wheeled out without further handling. The comfort to the furnace man in not having to work over a mound of hot slag is no small factor. Similarly, ashes from the firebox drop directly to trucks under the chute.

The furnace, which was built by the Tri-Cities company itself, is 50 feet x 10 feet outside the plates. The inside width is 7 feet 8 inches and between bridge walls there is an unbroken span of 27 feet. Thirty tons can be melted in an 8-inch bath. At present the Tri-Cities company is melt-

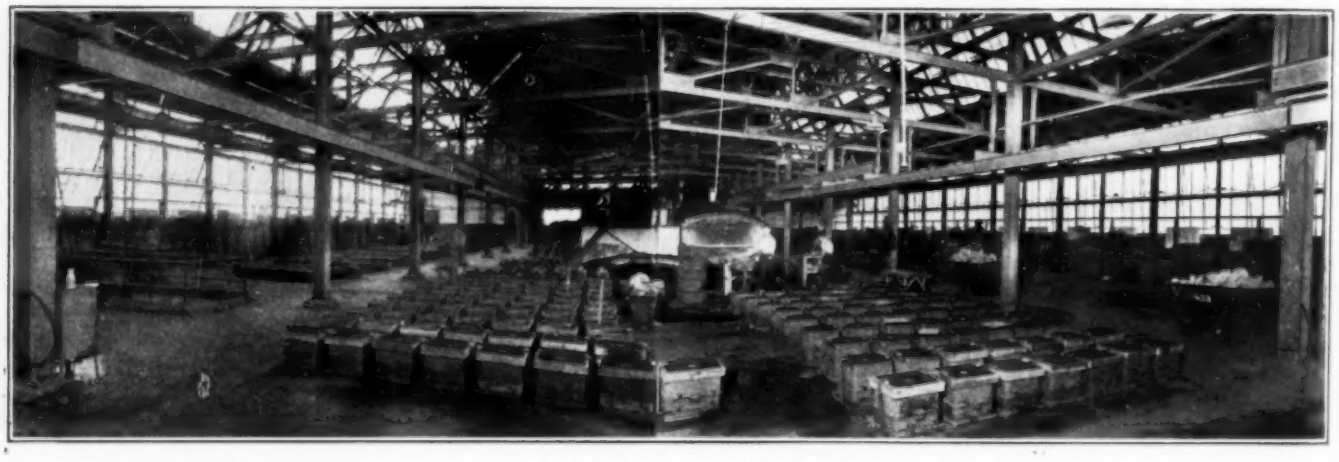


FIG. 12—MOLDING, MELTING AND POURING ARE HANDLED ON THE SECOND FLOOR—THE FURNACE IS NEAR ONE END

FIG. 13—TUMBLING BARRELS, GRINDING WHEELS AND SAND BLAST EQUIPMENT ARE LOCATED ON THE FIRST FLOOR

ing about 36 tons daily in two heats. The charge is 60 per cent sprue and scrap, and the remainder is pig iron of suitable analysis. Top draft is employed, at 3½ ounces pressure. The furnace is hand fired with eastern Kentucky coal. For charging the furnace there is a hand-operated crane made by the Ingersoll-Rand Co., New York, equipped with dump buckets and a compressed air hoist.

The molten iron is distributed in 1000-pound bull ladles via the monorail. After they are shaken out on the molding floor, the castings are collected in steel barrels, pushed to the hatchway and lowered to the first floor. Emerging in the cleaning room, the castings go through tumbling barrels manufactured by the W. W. Sly Mfg. Co., Cleveland. Gates are chipped off, the necessary trimming is done, and the castings are packed in boxes to be hauled to the annealing ovens by trucks supplied by the American Foundry Equipment Co., New York.

Although only in operation since last August the Tri-Cities company already has built up a reputation for smooth and scale-free castings. This is due in part to the skillful handling, the fact that the castings are packed in silica sand in the annealing pots and the design of the form annealing ovens, located in a detached sheet-iron structure just north of the main building. The unique feature of these annealing ovens is that the roofs are 18 inches higher at the firebox end than at the front. It is claimed that this form of construction insures a more even distribution of heat. These ovens have a capacity of 35 to 40 tons each, and are coal fired. The annealing pots are of a type made by the American Brake Shoe & Foundry Co.

The cooling beds for the annealing pots are on the first floor just east of the cleaning room. After cooling the castings are sand blasted, tumbled and ground in three mills and two sandblast barrels supplied by the W. W. Sly Manufacturing Co., Cleveland. All grinding wheels and tumbling mills are motor driven. All heavy castings turned out by the Tri-Cities company carry test lugs as a safeguard of quality. The shipping room is on the first floor at the middle-south side of the building.

At the easterly end of the building is a third floor, 50 x 80 feet, which serves as a machine and pattern shop. Light flows in from four sides. Here all iron flasks are surface ground at the parting line and on the bottom. The correct fit between copes and drags is insured by a round pin at one end and a slot at the other. Copes and drags are so drilled that the flasks are interchangeable. Between the second and third floor is a small mezzanine, housing an air compressor made by the Ingersoll-Rand Co., New York, driven by a 75 horsepower motor made by the General Electric Co.

As may be noted in the floor plan, the first floor is slightly below grade and has an average amount of window space. Along the north and south sides of the second floor are three tiers of ribbed wire glass. On the M-type roof are four similar tiers. Thus, on the north and south sides are seven tiers of continuous sash and on the east and west ends two. Each tier is operated by an individual motor. The end windows are stationary. It is claimed the window area is such that the air can be completely changed every 6 minutes. Heating in winter is provided by wall radiators. Bubbling fountains supply cooled drinking water. On the first floor are large locker and shower rooms for both men and women employes. The trusses of the steel and cement-tile roof do not rest upon columns but upon girders which transfer the load to the columns.

Although the daily output of castings averages between 800 and 850 pounds per man a 9-hour shift, contemplated improvements will make for further efficiency. Bins are to be placed under the railroad siding at the east end of the building, and a crane runway built over the bins at the level of the second floor. Then by dropping down with a long hoist, pig iron, coal, coke and scrap can be more swiftly and economically brought up. A new crane is to be installed for charging the furnace. The annealing building is to be connected with the main building by a sheet iron covering. At present, following the shakeout, castings are pushed on the monorail to the hatchway for lowering to the cleaning room. Ultimately the cleaning room will be placed directly under the molding floors and the castings will be lowered through the floor only a few feet distant from the shakeout.

H. C. Smith, formerly with the Danville Malleable Iron Co., is president of the Tri-Cities company. Other officers are: Vice president, F. S. Mangan, formerly with the National Malleable & Steel Castings Co.; secretary, E. M. Richardson, also formerly with the National company; and treasurer, G. E. Huntoon, formerly with the Moline Plow Co.

The Boston office of the Moltrup Products Co., Beaver Falls, Pa., has been changed from 201 Devonshire street to 80 Boylston street.

Discuss Handling and Metal Problems

At the spring meeting of the American Society of Mechanical Engineers, held at Cleveland May 26-29, in the paper "Fundamental Economies of Materials Handling," M. L. Begeman, assistant professor of mechanical engineering, University of Michigan, describes the economies that may be effected by the installations of suitable material handling equipment as follows: Production is increased, greater speed is obtained in the movement of the product through the plant, labor expense is reduced and floor space economized, overhead expense decreased, the management is relieved of many details, the quality of the product improved and the cost of financing a business is decreased.

Foundrymen will be interested in the papers presented at a joint meeting of the American Society of Mechanical Engineers and the American Society for Testing Materials in conjunction with the A. S. M. E. Spring meeting. A symposium presented included a paper on Industrial Application of Metals at Various Temperatures, by L. W. Spring, chief chemist and metallurgist, Crane Co., Chicago, Ill. This paper discussed the use of metals under high steam pressures and temperatures up to 750 degrees Fahr., also their use in the construction of stills, piping and valves for petroleum oil cracking where the pressures may reach 1000 degrees Fahr.

A paper prepared jointly by H. J. French and W. A. Tucker, United States bureau of standards, Washington, recorded the results of mechanical tests, special high temperature properties and tests and the trend of development of heat resisting alloys.

The final paper by Clair Upthegrove, assistant professor of mechanical engineering and A. E. White, professor of mechanical engineering, both of the University of Michigan, includes data on copper, copper-tin, phosphor, manganese, and aluminum bronzes, brasses, copper-nickel and copper-tin-zinc-lead alloys; gun, delta, monel, Davis, and bearing metals, nickel and nickel chrome; aluminum and its alloys.

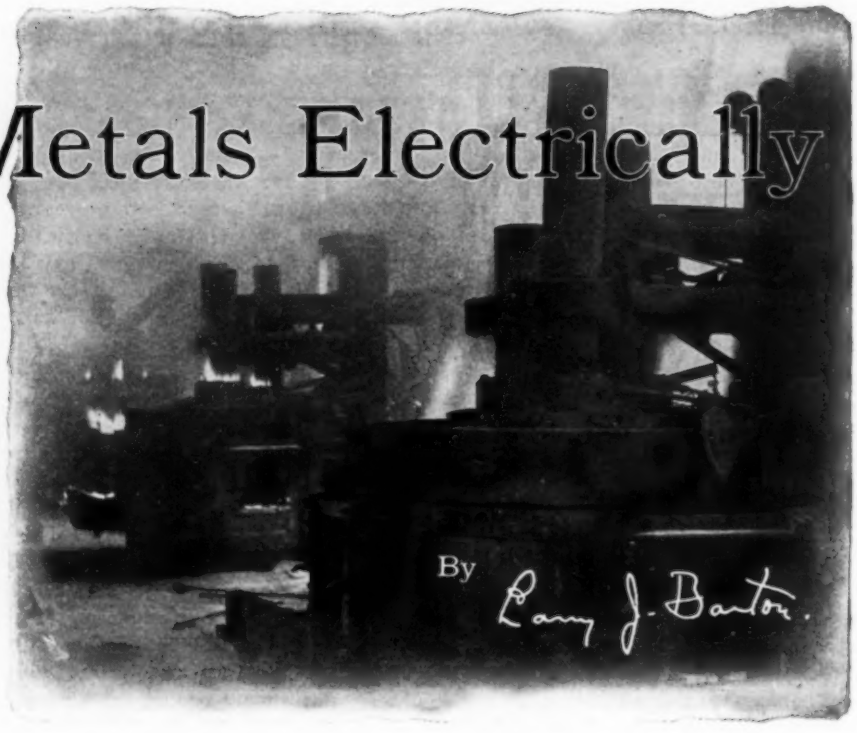
Transfer Ownership

The Worthington Pump & Machinery Corp., New York, has closed its power and mining works at Cudahy, Wis. All lines of products except the mining, crushing, cement and creosoting machinery have been transferred to other plants. The Allis-Chalmers Mfg. Co., Milwaukee, has taken over the records, drawings, patterns, pertaining to the three lines mentioned and will continue their manufacture at the West Allis plant.

Refining Metals Electrically

Chapter I (Continued)

Operating Costs May Be Governed by Size of Unit Selected



ELECTRIC furnaces are made commercially in sizes of from ¼ ton to 6 tons to be used for foundry work exclusively. Of the different sizes two find greater favor than any others. These range from ½ to 1 ton, and from 3 to 4 tons. Each size may be overloaded, but these are rated capacities usually favored.

Naturally, the prospective purchaser is interested in knowing which size will best meet his needs. It has been a common experience for a foundry to look ahead to contemplated expansion and buy a furnace too large for immediate requirements. Consequently this later stands idle part of the time. Conversely, the opposite has been true in cases when unseen expansion has occurred due to such conditions as striking oil in adjacent territory, large industrial expansion, etc., where the demand for castings rapidly increased.

It would appear upon snap judgment, that the advantage would lie with the larger size furnaces, due to their ability to handle a larger tonnage over a given period. When all of the points are considered, it appears that this advantage is little, if any. In fact it is the writer's opinion that the shop employing the smaller size furnace has a distinct advantage in the great majority of cases provided careful management governs.

In the careful calculation of this problem so many variable points are encountered that it becomes difficult to say positively that a 1-ton will prove superior to a 3-ton furnace. By small furnaces are meant those from ½ to 1-ton rated capacity, while large furnaces are understood to embrace those from 3 to 5 tons each, sizes larger than this being found infrequently in foundries.

Two main features should be considered in deciding upon the size of furnace necessary. These are: maximum sizes of castings to be made, and tonnage to be handled over a given time. If a company is engaged in manufacturing where castings over 3 tons in size frequently are required, the larger furnace will be mandatory. Similarly, if the company has an assured tonnage sufficient to operate the large furnace to capacity it is out of the question to think of a small sized unit. However, many companies are not in such a fortunate position, but are dependent upon a general line of jobbing castings for their income. Some are more fortunate in that a part of their output is used in manufacturing within their own plants. For the latter there is no question but that the smaller unit will prove more suitable. The advantages of the small type furnace may be summarized as follows:

It is much easier to obtain the tonnage necessary for the economical operation of a small furnace than it is for a larger installation.

It has been found in actual practice that of the work handled in a 3-ton furnace shop, from 80 to 90 per cent could be cast from a small furnace.

On classes of work too large for the small furnace added competition is offered by the large open-hearth shop, always eager to bid on tonnage work.

The power demand is much smaller on the small unit, and during slack times when the furnace is not in steady operation this means a saving in fixed charges of from $500 to $1000 per month, depending upon the power schedule.

Naturally the primary outlay will be much smaller on the 1-ton furnace. Further, the building will not need so much floor space due to the fact that smaller heats are poured at short intervals. The building, and crane runways can be built much lighter. The auxiliary equipment such as ladles, sand mixers, mold and core ovens, annealing furnaces, and miscellaneous cleaning equipment are much smaller. The number of flasks needed is much smaller, due to the greater turnover. Many other points might be suggested indirectly in favor of the small unit. However, for further calculations it may be assumed that the cost of the items mentioned varies directly in proportion to the size of melting equipment.

Continuous Operation Favored

A main item in an electric furnace foundry is to be able to run continuously, to conserve the heat left in the furnace from the previous melt. The small unit is favored on this count. Heats of 1000 pounds can be made at a time and thus it becomes easy to keep the furnace in operation by working on different classes of metal. Common steel

Size and Economy

WHAT points should be considered in choosing the right size electric furnace? Does economy in operation favor the unit ranging from 4 to 5 tons capacity per charge or the smaller type? These and other questions which serve to determine the choice in selecting a proper melting medium are weighed by the author in the accompanying article which is the second of a series on electric furnaces, their operation and maintenance. The preceding installment, which was presented in the June 1 issue, compared the electric furnace with other melting mediums adapted to handling steel and alloy metals and gave attention to the factors of cost, quality of metal and other prime characteristics. The next section which will appear in an early issue takes up the two main classifications, basic and acid lined furnaces.

castings may be made as the main product, and orders for small lots of special metal such as chrome, nickel, or manganese steel castings may be taken with profit. Under these conditions of operation, the cost of conversion becomes low, and with a fair power charge, gray and white iron castings may be made cheaper than in the cupola. Operating in this manner the furnace is kept busy and cheap operating figures, with their attendant profit naturally follow.

Superintendence seems at first glance to offer a problem. How is the shop with a small tonnage able to attract, and hold the high priced man? In the shop operating a 3-ton furnace, a superintendent at say $5000 a year, a melter at $3000, a foundry foreman at $3000 and a cleaning room foreman at $3000 will be necessary. Naturally, in the small shop it is impossible to have such an array of talent. Therefore, the solution is to obtain for superintendent a first class metal man who can handle the executive problems, who can break in his furnace crews, and who can oversee both the molding and cleaning. Such a man is worth $5000 or more. He will need the assistance of a first class molder who can be elevated to the position of a subforeman at about $175 per month, or $2100 a year. Under these conditions the size of the superintendent's duties will be just sufficient for him to handle the work with the highest efficiency, and as everything will be always at his finger tips he will function with the least amount of lost motion. In some shops the superintendent walks around and looks wise. Why not put him to producing?

Comparative Production Costs

Now comes the crucial test in comparing furnace sizes. How much will the cost of finished castings from the two units vary? Several factors must be studied to determine the proper rating on this basis.

Fixed Charges

Assume conservative figures for output. Using acid operation the 3-ton unit will pour from three to four heats in 8 hours; and from seven to eight in 16 hours. The small unit will pour five to six heats in 8 hours; and from 11 to 13 in 16 hours. Assuming the large heats to be 4 tons each, and the small ones 1 ton, the following figures are obtained:

	½ to 1 ton unit	3 to 4 ton unit
8 hour operation	5 tons	12 tons
16 hour operation	11 tons	28 tons

Taking the conservative figure of 8 hour operation the yearly tonnage for the small furnace will approximate 1500 tons, while that for the 3 to 4-ton unit will be 3600 tons.

Assume that the total cost for the one ton shop is $50,000 and that for the three ton one amounts to $150,000, we obtain figures on fixed charges of $7000 and $21,000. These figures cover all points of depreciation, amortization, repairs, etc., figured on the same basis for both installations.

Superintendence

This, as shown before, will amount to $7100 for the small unit, and $14,000 for the larger type of melting furnace.

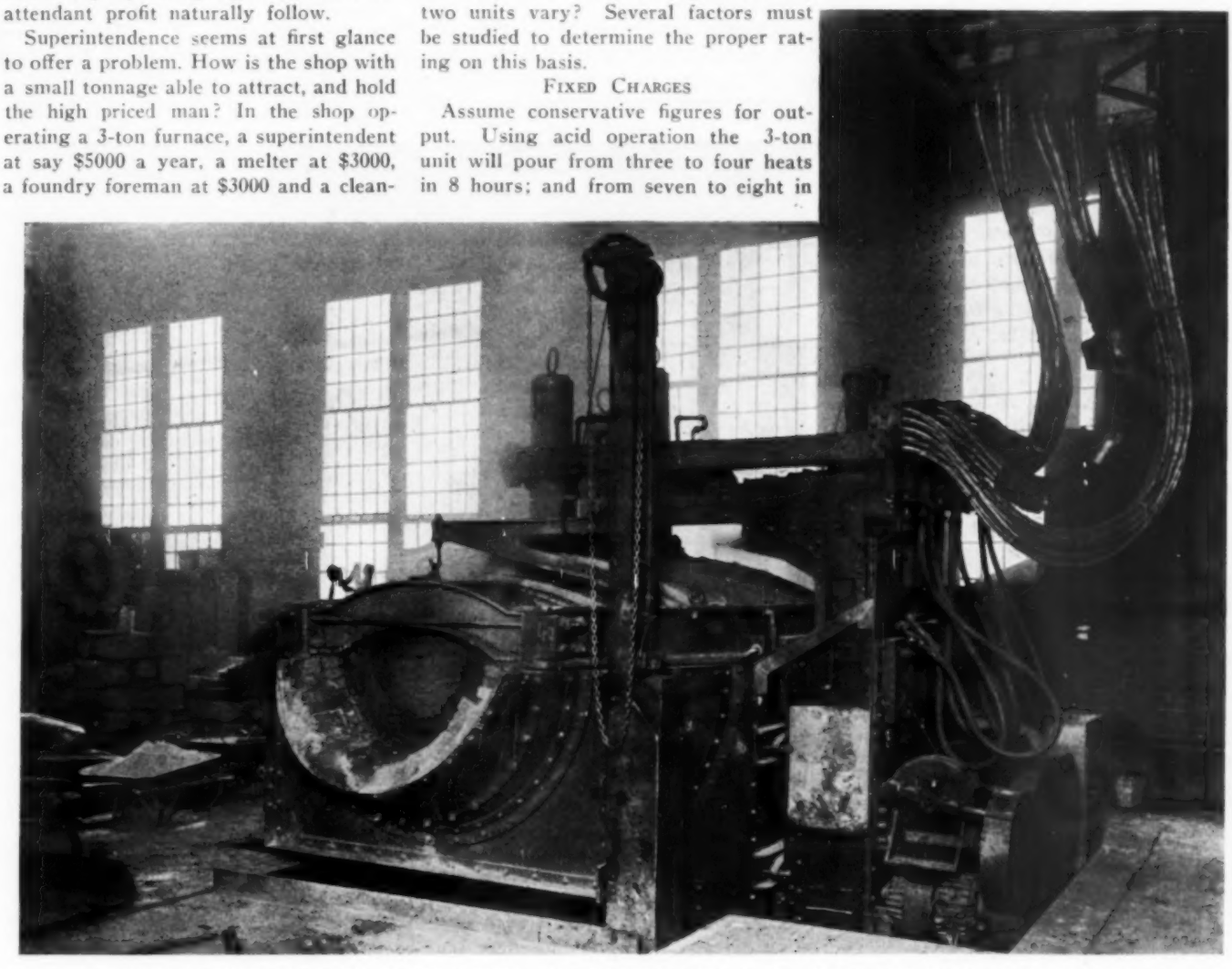


FIG. 4—A FURNACE INSTALLED ON FLOOR LEVEL AND TAPPED INTO A PIT—NOTE THE EASY ACCESSIBILITY OF SUPPLIES AND OTHER FURNACE NECESSITIES

Cost of Metal in the Ladle

The following figures are taken from actual operating sheets:

Kilowatt Hours Per Ton

Heat Number	Small furnace	Large furnace
1st	750	700
2d	700	600
3d	600	530
4th	550	
5th	550	
Average	630	610

While the smaller furnace has the advantage of a more continuous operation, with its attendant saving in power, the

larger unit has the advantage of a higher thermal efficiency, and thus the average power consumption favors the 3-ton furnace. However, another point must be considered, namely, the demand charge. The demand will be 500 kilowatts for the small furnace ,and 1500 kilowatts for the large size. The power companies usually make a fixed charge of so much per KWH of demand. This can be shown in the following table:

	1 ton	3 ton
Average kilowatt-hour per ton	630	610
Monthly consumption	78750	183000
at 1 cent per kilowatt-hour	$787.50	$1830.00
Maximum demand	500	1500
at 1 cent per kilowatt-hour	$500.00	$1500.00
Total power cost	$1287.50	$3330.00
Power cost per ton	$10.30	$10.10

Labor Costs

On the small furnace two men will be ample to take care of all melting, charging, and ladles. On the larger unit where greater amounts of scrap are needed a greater amount of help will be required. The following table gives the comparative labor costs:

	Small furnace	Large furnace
1 melter at 75 cents	$ 6.00	$ 6.00
1 helper at 50 cents	4.00	4.00
1 ladleman at 50 cents	....	4.00
2 chargers at 30 cents	....	4.80
1 scrap craneman at 60 cents	....	4.80
	$10.00	$23.60
Per ton	$ 2.00	$ 1.97

Other Items of Cost

Under this heading are placed refractories, patching materials, electrodes, alloys, ore, tools, water, etc. While the cost per unit to line the larger furnace will be smaller, the efficiency will not be so great, and it is reasonable to assume that the miscellaneous items will average the same for both size installations. The following comparison therefore may be made:

Small Unit	
Conservative Yearly Tonnage	1500
	Cost per ton
Fixed Charges at $7000	$ 4.67
Superintendence at $7100	4.73
Power	10.30
Furnace Labor	2.00
Total Cost per Ton	$21.70
Large Unit	
Conservative Yearly Tonnage	3600
	Cost per ton
Fixed charges at $21,000	$ 5.83
Superintendence at $14,000	3.89
Power	10.10
Furnace Labor	1.97
Total Cost per Ton	$21.79

Under this final test of actual cost, it is shown that the small furnace compares favorably with one of larger capacity. However, before making any decision it will be best to tabulate as many different points as possible on the two units that all facts pertaining to the problem may have ample consideration. These are given in the following summary and from a careful examination of these the writer has drawn his conclusion that the electric furnace of from ½ to 1 ton capacity is a commercial success, and, furthermore, except under unusual conditions it is preferable to the larger sizes for general jobbing work, especially where the installation is a new venture into the steel casting business. The points which favor the smaller furnace follow:

Ability to meet competition
Adaptability
Supervision
Primary costs
Cost of metal
Quality of metal
Ease of handling
Return in clean castings
Money tied up in supplies
Possibilities for profit

In many installations the electric furnace is placed at one end of the shop, provision being made in most cases for a second unit should it become necessary. Placing the furnace in such a position gives a clear molding floor, and provides a space for all items such as ladles, etc. Thus the melter has all his accessories directly under his eye where he can keep close touch, the ladles coming under the steelmaker's supervision.

Such a location permits straight line routing, the scrap being brought in from the yard behind the furnace, and passed down the floor as molten metal with a minimum of handling. Some furnaces are arranged in a side bay so that they are tapped into the main molding bay. This is satisfactory for small furnaces where the electrodes can be handled by hand, but necessitates the use of some sort of swing crane when changing roofs. For furnaces of 2 tons and over, it is vastly preferable to locate the melting equipment under a traveling crane.

The furnace itself may be placed either on a platform or at the floor level. A furnace situated on the floor level is preferable for many reasons. All supplies such as sand, coke, alloys, scrap, etc., may be brought conveniently to the point of use in trucks or wheelbarrows. The melter can look over the pouring, examine the ladles, etc. The only disadvantage of this setup is the fact that a deep pit is required which in certain localities may allow a seepage of water, but if periodic attention is paid to emptying the pit or to permanent drainage, this offers no great difficulties. The two methods of placing the furnace are shown in Figs. 4 and 5.

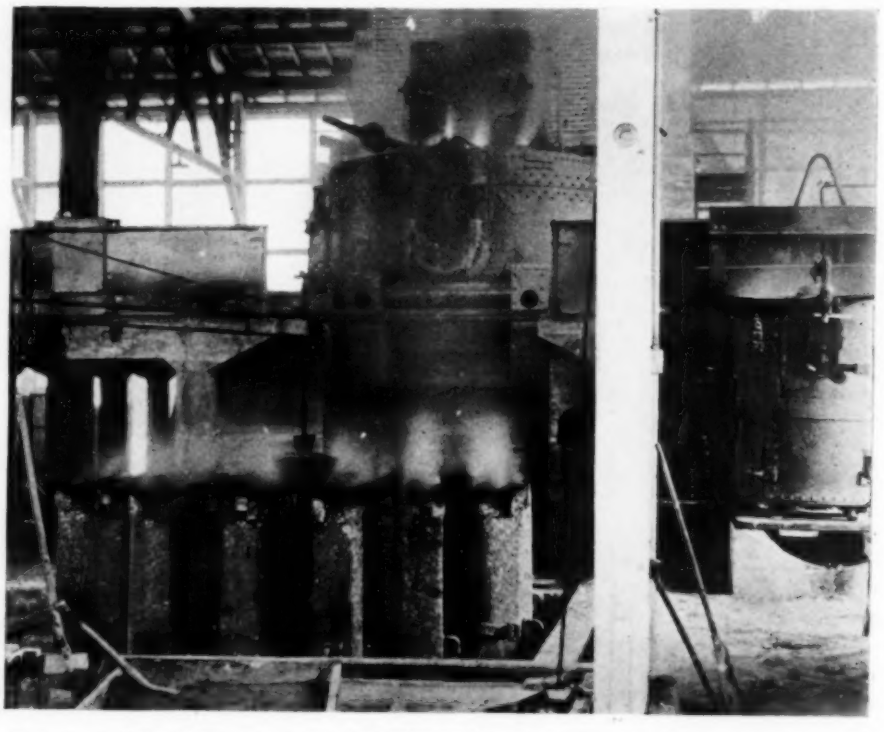


FIG. 5—A FURNACE ON A PLATFORM—NOTE THE HEAVY AND COSTLY CONCRETE CONSTRUCTION REQUIRED—IN ADDITION THE CRANE MUST BE USED TO BRING EVERYTHING NEEDED FROM THE FLOOR UP TO THE MELTING PLATFORM

The furnace being decided upon the next step will be the consideration of the product to be made. This tends to determine the make of furnace to purchase and controls the method of operation, whether acid or basic. While many furnace makers claim that their equipment will work as well on acid as on basic operation and vice versa this is not strictly true. Certain furnaces are intended for rapid acid operation and in practice prove too fast for the slow refining necessary for good basic steel. Again, furnaces designed for basic conditions are far too slow for the rapid melting necessary under heavy acid steel production. Therefore the next article will give data on the examination of product which will determine whether acid or basic operation is to be used.

Discusses Permanent Molds-I

After Sketching the History, Five Different Permanent Mold Processes Are Described Followed by a Discussion of the Principles Involved Illustrated by Typical Molds

BY ROBERT J. ANDERSON AND M. EDWARD BOYD

INTEREST always has been displayed in attempts to devise and employ molds, permanent or semipermanent in character for the production of castings. Always a desire has existed on the part of the foundryman to devise a method to eliminate the necessity of destroying the mold after it has served its purpose in the production of a single casting.

The principles involved in the production of castings in permanent molds of various kinds have been known and practiced since 3000 B. C. The permanent mold process antedates the sand casting process by thousands of years as evidenced by the stone and bronze molds employed by the ancients for casting weapons, ornaments and tools. Johnson covered this subject in an interesting and comprehensive manner several years ago[2].

Theories based on available evidence indicate that the first molds employed by man were open on one side, formed of clay and burned hard. These molds probably only were semipermanent and only lasted for a few heats. Few are in existence today. The open stone mold

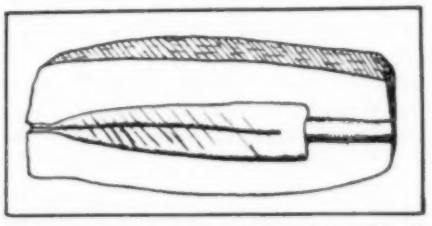


FIG. 2—HALF OF COMPOUND STONE MOLD USED FOR CASTING A TANGED KNIFE

dates from about the same period. Large numbers of these molds have been found in the excavations of ruins and now are preserved in various museums. This type of mold was made by gouging a cavity in the face of a soft rock, sandstone, micaceous slate or soapstone. The design usually is simple and is reflected in the castings of the period, flat axes, celts and other castings of the same general character. Copper or bronze was poured into a mold of the approximate shape required and the casting afterward was hammered to a finished shape and sharpened on a stone. The mold shown in Fig. 1 used for casting a celt was found near Ballymena, County Antrim, Ireland.

Compound clay and compound stone molds followed the open clay and stone molds. These compound molds were formed in halves and some of the specimens exhibit truly remarkable skill and ingenuity on the part of the makers. The mold cavity and gates were cut in the two halves of the mold and to a remarkable extent the early mold is similar in principle and design of operation to the permanent mold of today.

Half a stone mold found near Ballymoney, County Antrim, Ireland, and used for casting a tanged knife is shown in Fig. 2. The mold cavity was cut in close grained sandstone. Half a similar mold for casting a dagger blade is shown in Fig. 3. Over a presumably long period of time the compound stone mold was developed to a high degree of perfection and was employed for casting daggers, sword blades, spear heads, other weapons and miscellaneous tools. Fig. 4 shows half a compound stone mold found on the island of Crete. This mold was cut in a block of soapstone. Stone, terra cotta and some kind of wax molds were used by the ancient Peruvians and Fig. 5 shows a gold figure ornamented with filigree work cast in Colombia probably from a wax pattern in a built-up mold. The filigree work is an integral part of the casting and is not soldered in place.

Bronze molds followed the stone molds and marked another advance in the progress of the art of casting. Bronze molds withstood the erosive action of liquid copper and bronze better than the clay and stone molds. They have been found in large numbers in northern France and in England. A bronze mold used for casting gouges and found near Plenee Jugon, Brittany, is shown in Fig. 6. This was a cored mold and when the halves were assembled a bronze pin was inserted through the transverse hole shown in the left half to hold the core in place.

One half copper mold used for cast-

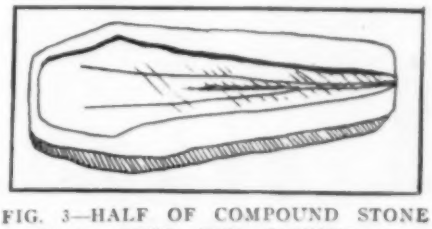


FIG. 3—HALF OF COMPOUND STONE MOLD USED FOR CASTING A DAGGER BLADE

Acknowledgement

The writers wish to acknowledge with thanks information supplied by foundrymen employing permanent molds and by metallurgists and engineers connected with the foundry industry. Photographs of permanent molds in France were forwarded by Dr. Leon Guillot. Other photographs were loaned by Dr. G. M. A. Richter, of the Metropolitan Museum of Art, New York; by Dr. C. W. Mead of the American Museum of Natural History, Washington and by Dr. B. Laufer of the Field Museum of Natural History, Chicago. Other acknowledgements are made specifically in the text of the accompanying article.

1. Annual exchange paper of the American Foundrymen's association presented at the Newcastle meeting of the Institute of British Foundrymen, June 10. The joint authors, Robert J. Anderson and M. Edward Boyd, are respectively metallurgist and former assistant metallurgist at the United States bureau of mines experiment station, Pittsburgh.

2. Johnson, F. The Casting of Nonferrous Metals in Chill Molds, *Proceedings* British Foundrymen's association, Vol. for 1916-1916, pages 140-176.

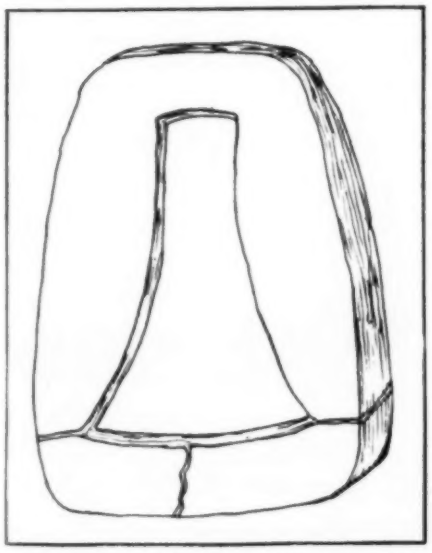


FIG. 1—OPEN STONE MOLD FOR CASTING A CELT

FIG. 4—HALF OF OPEN STONE MOLD FROM THE ISLAND OF CRETE

ing a spear head is shown to the left in Fig. 7 and the casting itself is shown to the right. The mold was obtained at Si-Anfu, China, and apparently dates from the third or second century B. C.

The discovery of iron and steel and the employment of these materials for weapons and implements demanded new methods of founding and resulted in the development of the sand mold. This mold with minor modifications is used up to the present for the production of the great majority of castings.

Early in the 19th century foundrymen again began to turn their attention toward the subject of permanent molds and intermittently it has been a live subject ever since. The problem of casting iron and steel in permanent molds presents greater difficulties than where the same process is attempted with nonferrous alloys. The permanent mold has attracted considerable attention in recent years in connection with centrifugal casting methods with both iron and steel, but the permanent mold process in general application has not yet been adopted extensively on account of the inherent mechanical and metallurgical features involved. Even with nonferrous castings, commercial production has been limited to some extent to small castings of simple shape.

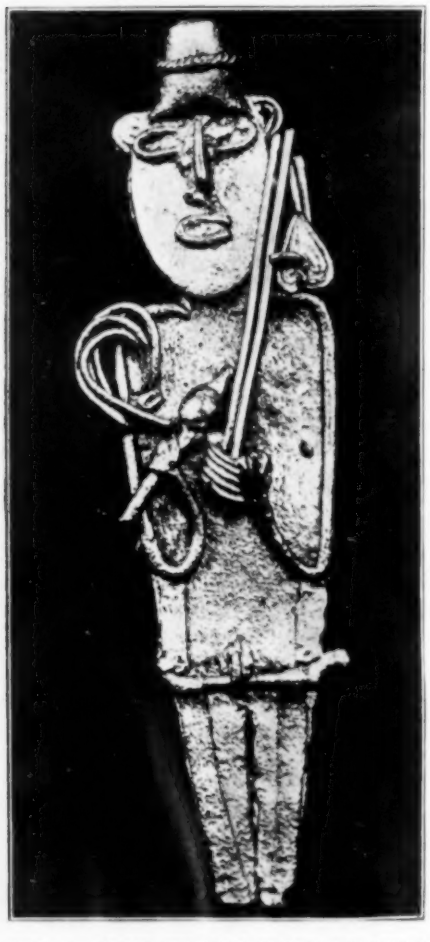


FIG. 5—GOLD FIGURE WITH FILIGREE WORK FROM COLOMBIA

The cast iron mold as it is known and used today made its first appearance about 150 years ago, but the creation of permanent mold casting as an important and separate industry is a comparatively recent achievement. Advantages claimed for over those made in sand molds the castings include: (1) Permanent mold castings are more accurate and uniform in size and weight, (2) machining either may be greatly reduced or eliminated entirely, (3) permanent mold castings present a better surface appearance, are more homogeneous and have better mechanical properties, (4) the permanent mold process is continuous, production costs are lower and production is increased, (5) unskilled labor replaces skilled molders, (6) in certain instances parts impossible of reproduction in sand may be made in permanent molds.

Machining cost is an important factor in modern metal manufacturing methods and any process which promises a reduction in this item is worthy of consideration. Almost any casting within reasonable limitation of size and coring may be cast in a permanent mold. Except for the removal of gates and fins, the casting requires no surface dressing after it is taken from the mold. The automobile industry with its insatiable requirement for large numbers of small and medium weight castings offers a fertile field for the development of the permanent mold.

About 1902 E. A. Custer began experimenting with permanent molds at the Tacony Iron Co., Philadelphia, [3] [4] [5] [6] [7] [8] and a process was developed for casting soil pipe, sashweights and small pipe fittings. In one installation 30 pipe molds were mounted on a revolving table and rotated at a speed that presented each mold in front of the ladle at 7-minute intervals. The average production was at the rate of 240 castings per hour. To avoid the chilling effect of the iron mold the castings were removed from the molds the instant they solidified. Radiators, brakeshoes, cylinder blocks and other cast iron parts have been produced by the permanent mold process in recent years. The Holley Carburetor Co.,[9] Detroit, has developed a method for casting iron in a type of permanent mold that differs slightly from others.

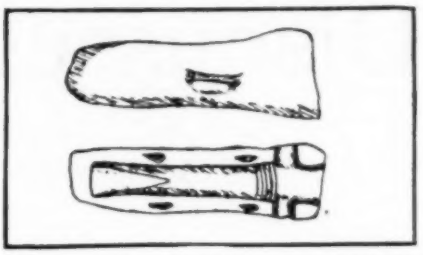


FIG. 6—TWO HALVES OF BRONZE MOLD FOR CASTING GOUGES

The mold is made of ordinary gray iron but in use the interior surface is coated with a thin layer of clay and sodium silicate or other suitable binder and this lining is covered with a thin coating of amorphous carbon.

In the nonferrous field the permanent mold process is used extensively for casting brass, bronze, aluminum bronze and light aluminum alloys and it may be applied to the production of any of the commercial alloys.

To avoid confusion incident to the manner in which terms loosely are applied in the foundry it may be of interest at this stage to point out that five different commercial processes involve the use of metal molds. These are: Die casting, slush casting, Gothias casting, centrifugal casting and permanent mold casting. This paper primarily is intended as a discussion of permanent molds and therefore, the first four processes indicated will be touched upon briefly and merely for the purpose of distinguishing them from the fifth method.

3. Anonymous. The Szekely Process of Casting Metallic Molds. *Engineering*, Vol. 85, 1908, pages 16-17.

4. Custer, E. A. Casting Pipes in Permanent Molds. *Iron Age*, Vol. 81, 1908, pages1227-1234.

5. Custer, E. A. The Permanent Mold and Its Effect on Cast Iron, *The Foundry*, Vol. 45, 1909, pages 121-124.

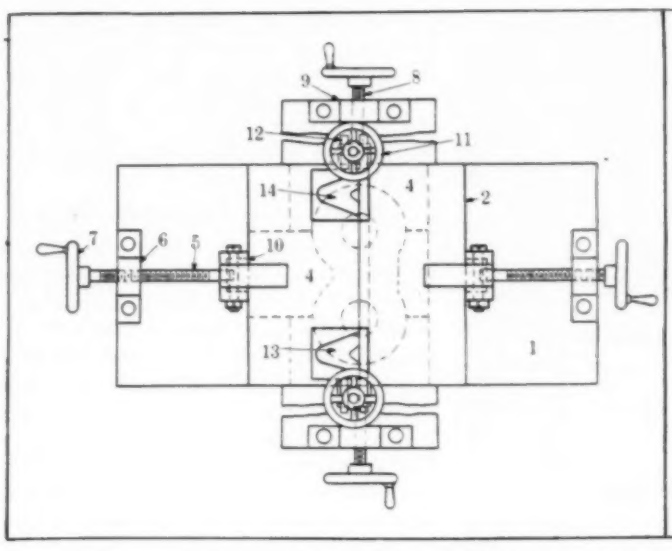
6. Custer, E. A. Permanent Molds for the Iron Foundry. *American Machinist*, Vol. 32, 1909, pages 148-153.

7. Oberg, E. The Custer Process of Casting in Permanent Molds, *Machinery*, Vol. 17, 1911, pages 729-732.

8. Custer, E. A. The Efficiency of the Permanent Mold, *The Foundry*, Vol. 38, 1911, pages 19-21.

9. Moldenke, R. A New Long Life Mold Development, paper presented before the Cleveland convention of the American Foundrymen's association, May, 1923.

FIG. 7—ABOVE—HALF COPPER MOLD FROM CHINA—BELOW—SPEAR CAST THEREFROM



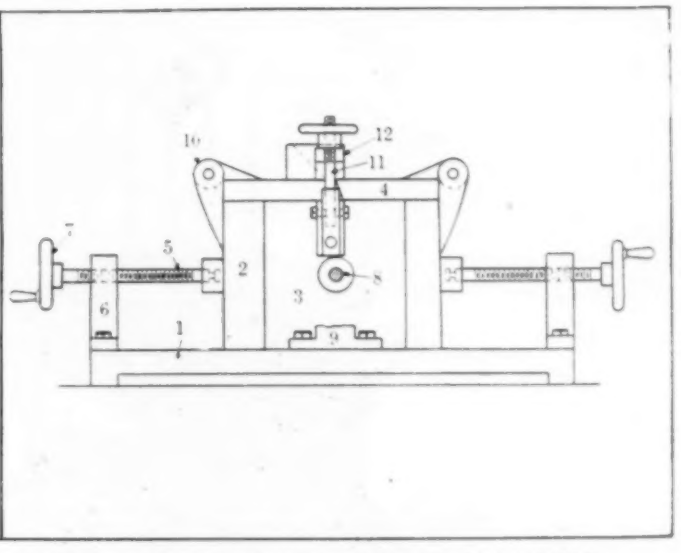


FIG. 8—PLAN OF SZEKELY PERMANENT MOLD CLOSED FIG. 9—END VIEW OF THE SAME MOLD

A die casting may be defined as a finished or practically finished casting made by forcing liquid metal under pressure, into a metallic mold. Die castings sometimes are confused with articles formed by pressing hot or cold metal parts between a pair of dies.

Die casting essentially is a quantity production process and usually is not applicable to jobs in which less than 1000 castings are required. The heavy expense involved in the preparation of the dies must be distributed over the product. On a commercial basis it is apparent that the ultimate cost of any die casting must be less than the cost of a sand casting plus the added cost of machining. The die casting process is employed commercially for tin-rich, zinc-rich, lead-rich and aluminum-rich alloys. Alloys of higher melting points, brasses and bronzes, may be die cast but the erosive effect of these alloys on ordinary steel dies is detrimental to a point that precludes their use commercially. Dies for aluminum alloy work usually are made of chrome-vanadium steel.

Small interchangable parts which must be well finished and accurate in dimensions are particularly well adapted to production by the die casting process. For detailed description of the process attention is directed to a great number of articles that have appeared in the technical press during recent years by Pack,[10] [11] [12] Carman[13] and Harriman.[14]

10. Pack, C. Die Castings and Their Application to the War Program, *Transactions* American Institute Mining Engineers, Vol. 60, 1919, pages 577-586.

11. Pack, C. The Relation of Die Casting to Foundry Practice, *Transactions* American Foundrymen's association, Vol. 29, 1921, pages 40-493.

12. Pack, C. Developments in Die Casting Practice, *Machinery*, Vol. 29, No. 4, 1922, pages 291-293.

13. Carman, A. C. Equipment for Making Die Castings, *Machinery*, Vol. 29, No. 4, 1922, pages 261-263; Dies for Die Casting, Vol. 29, No. 5, 1923, pages 369-370; Vol. 29, No. 6, pages 430-432; Metals Used for Die Casting, Vol. 29, No. 7, pages 516-518.

14. Harriman, J. W. Die Casting Processes and Equipment, *American Machinist*, Vol. 58, 1923, pages 137-141.

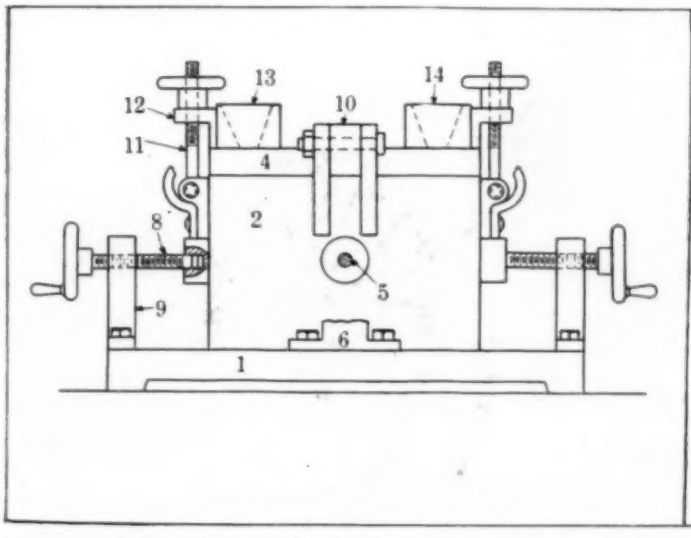
Also to a small book published by the *Industrial Press*.[15]

A slush casting may be defined as a practically finished casting made by filling a metallic mold with a liquid alloy and then after the metal in contact with the mold has frozen sufficiently to form a shell of the desired thickness, the mold is inverted and the remainder of the metal is poured out and returned to the melting pot. Molds employed for this process usually are made from brass or bronze and the castings are poured from a zinc-rich or other alloy with a low melting point. The process and details of operation and construction of the molds have been described by Rigg and Morse.[16]

A Gothias casting is a finished or partly finished casting made by first pouring a measured quantity of a suit-

15. Anonymous. Die Casting, *The Industrial Press*, New York, 1921.

16. Rigg, C. and Morse, H. C. Effects of Common Impurities in Spelter on Slush Castings, *Transactions* American Institute of Metals, Vol. 9, 1915, pages 26-36.



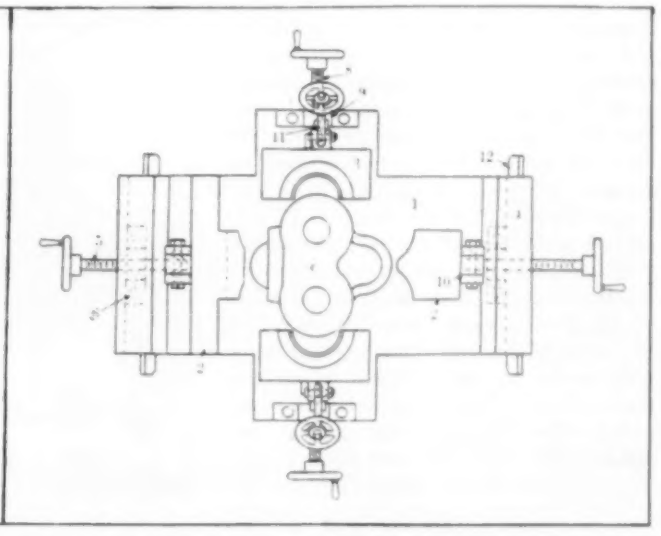


FIG. 10—FRONT ELEVATION OF THE MOLD AS SEEN FROM THE LEFT OF FIG. 9. FIG. 11—PLAN OF PERMANENT MOLD IN OPEN POSITION

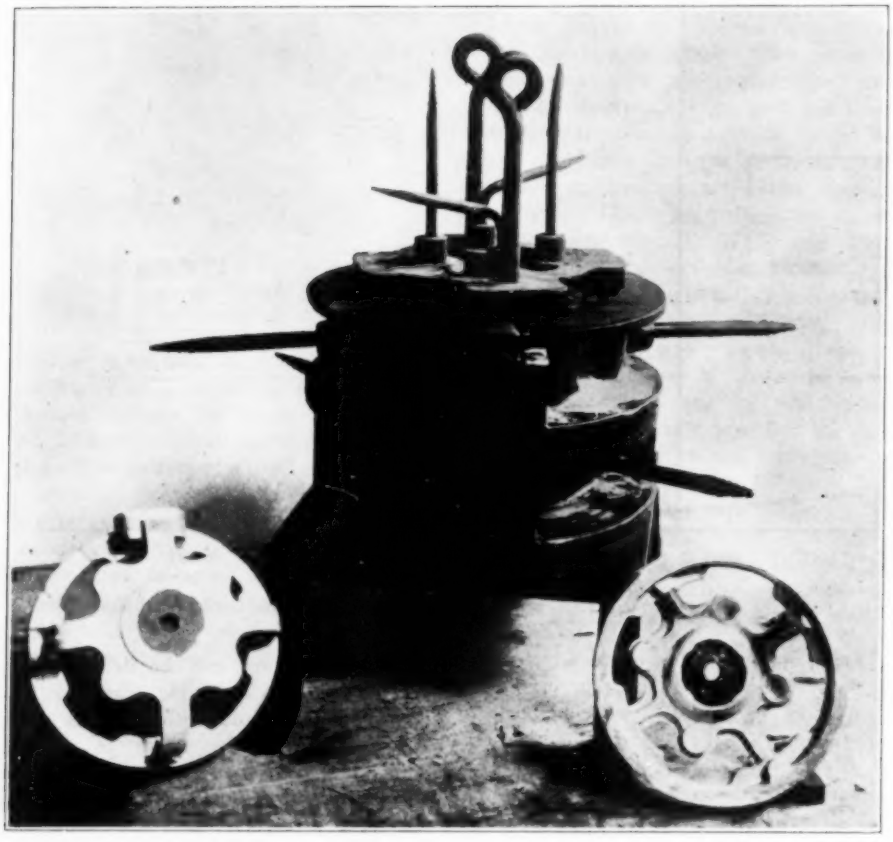


FIG. 12—PERMANENT MOLD FOR MAKING DYNAMO STARTER CASTINGS IN ASSEMBLED POSITION

able alloy into a metallic mold and then forcing a top part of the mold containing any necessary cores into the metal, thereby giving internal shape to the casting. The method is analogous to that employed in the glass pressing industry. The method is employed for making thin walled castings of fairly open shape, but is not applicable to complicated box castings with many cores. In England the method finds extensive application in the production of simple crankcases, transmission cases, cylinders and pistons for automotive construction. The Gothias system is little known in the United States. The process is described in an anonymous article.[17]

A centrifugal casting is a finished or semifinished casting made by pouring metal into a rotatable permanent mold. The mold is whirled rapidly while the metal is in a molten condition and as a result the metal is thrown by centrifugal force against the mold wall thus assuming the desired shape. The centrifugal machine consists essentially of a revolving mold and a spout through which the molten metal is delivered. Molds may be rotated vertically, horizontally or on an incline. Molds are made of cast iron, alloy steel and cast iron lined with various compounds. They are operated warm, hot and water cooled. The warm mold by which is meant the mold that does not become hot in service and requires neither a torch for preliminary heating nor a cooling device later, represents the first development in this process. Water cooled molds of which the deLavaud machine is typical are employed commercially for the production of water pipe. A hot mold which facilitates casting thin sections and made of special high chromium steel recently has been developed by Cammen.

The centrifugal casting method has been applied successfully to the production of pipe, car wheels, propeller shaft sleeves, paper mill rolls, tubes and other parts in ferrous and nonferrous metals. The process described by Cammen,[18] [19] [20] is comparatively old but it did not assume any marked importance until 1914.

What Is a Permanent Mold

A permanent mold in its proper sense is a mold in which the metal enters and fills the mold by gravity. The only feature in which it differs from the ordinary sand mold is in the character of its composition and in the fact that it may be used repeatedly. At times objections have been advanced against the term permanent mold on the ground that the mold does not last indefinitely and occasionally needs repairs. No piece of equipment actually is permanent, but when several hundred thousand castings are poured in a mold, it may be regarded as permanent for all practical purposes.

Where collapsible or other steel cores are used in a permanent mold the molten metal is poured into a previously heated and assembled mold. After a definite period of time, usually measured in seconds, the cores are removed, the mold is opened and the casting is removed. The mold then is reassembled, the cores are inserted in reverse order to their removal and the mold again is ready for the metal. In many instances sand cores are employed in connection with permanent molds.

Permanent mold process like that of die casting is a quantity production proposition. It is not considered practical with orders for less than 500 or 1000

17. Anonymous. Aluminum Chill and Die Castings, *Metal Industry*, (London), Vol. 16, 1920, pages 431-432.

18. Cammen, L. Chromium Alloy Steel Cast Centrifugally *Iron Age*, Vol. 110, 1922, page 655.

19. Cammen, L. Casting Steel Ingots Centrifugally. *Iron Age*, Vol. 110, 1922, pages 1494-1496.

20. Cammen, L. Centrifugal Casting, paper presented before the Cleveland meeting of the American Foundrymen's association, May, 1923.

FIG. 13—THE SAME MOLD SHOWN IN FIG 12 WITH THE VARIOUS COMPONENT PARTS EXPOSED TO VIEW

castings. Considerable expense is incurred in making the molds, although the cost usually does not approach that of dies for use in the die casting process.

Sand casting, die casting and permanent mold casting are competitive processes, while Gothias casting, slush casting and centrifugal casting methods occupy rather isolated positions except in the production of special types of castings. In considering the various processes the producer of castings is interested in knowing the advantages and disadvantages of each, also their scope and application.

Occupies a Distinct Field

In a general way it may be stated that the permanent mold process occupies a distinct field midway between that of the sand cast and die cast methods. For large lots of castings adaptable to the process the permanent mold method is preferable to the usual sand method. The castings may be made more cheaply, more rapidly and to closer size and weight tolerances. Other advantages have been touched upon previously. On aluminum alloys for large castings and for complicated small castings, the sand casting method appears to yield the best results. For small, simple castings and even fairly complicated small castings the die casting method is eminently satisfactory.

Recent progress in the adoption of the permanent mold indicates that the size and complexity of the casting is limited only by the ingenuity of the mold designer. Many castings now are made in the sand foundry which could be made more profitably by die casting. Also some castings are made in permanent molds which fall in the same category. The contrary is true in other instances and the correct method only may be determined by a careful consideration of every factor in connection with the proposed casting.

The rate of output by permanent mold casting is more rapid than by sand casting but less than by die casting. Production speed depends on the size and type of casting, the composition of the alloy, and the type of mold, that is whether it is automatic or hand operated. Speed of operation may be increased on small simple castings by connecting several individual cavities with a single runner or by connecting several cavities with each other as in a sand mold. The die casting process has the great advantage of speed and accuracy and is much more economical than either sand or permanent molds for certain castings. From an engineering construction viewpoint permanent mold castings are superior to those made either by the sand or die casting process. It is claimed they possess better physical properties, the metal is close-grained and free from blowholes or porosity. Practically any alloy or metal may be cast centrifugally but the process is limited in its application to certain types of castings.

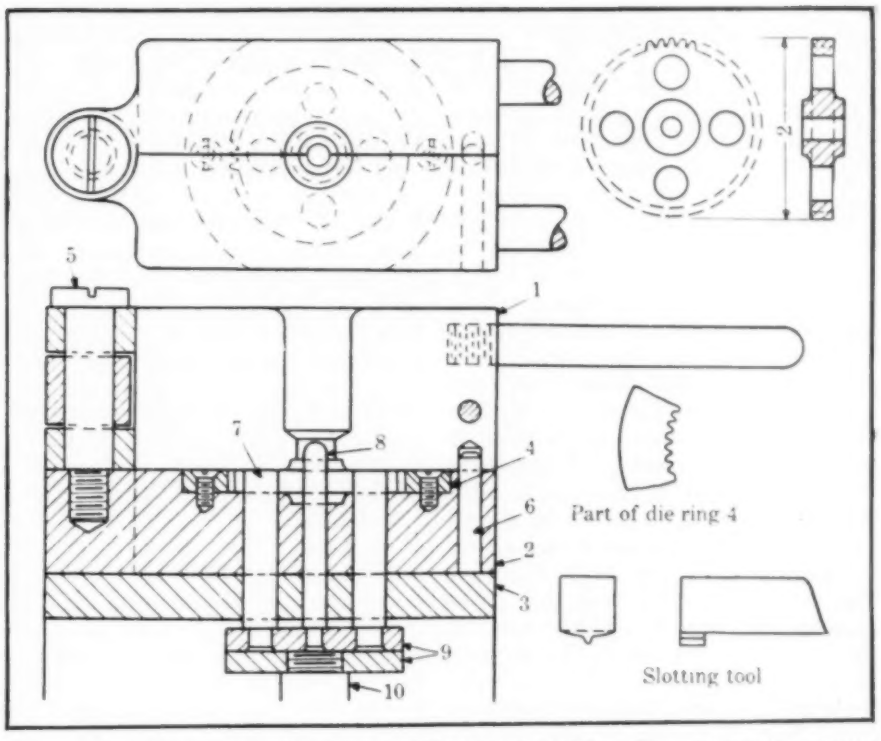


FIG. 15—DETAIL DRAWING FOR PERMANENT MOLD FOR CASTING SMALL GEAR WHEEL

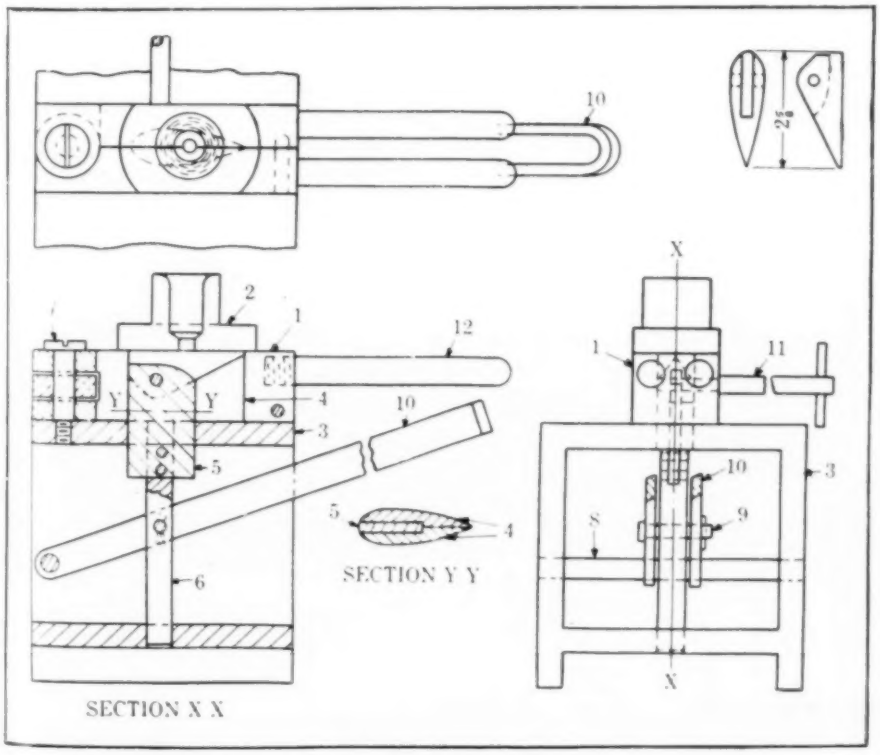


FIG 14—DETAIL DRAWING OF PERMANENT MOLD FOR MAKING PACKING PIECES FOR AIRPLANE STRUTS

Permanent Mold Requirements

Successful production of permanent mold castings hinges on three definite features: A metallic mold capable of withstanding erosion from the liquid metal and the rapid changes in temperature; a suitable casting alloy; a design of mold and casting and a method of gating that will insure sound castings. Many important factors regulate the operation of permanent molds including the following: Temperature of the mold, pouring temperature of the metal, speed of operation, order in

which core inserts are removed, size and location of gates, risers, feeders, vents, etc.

Fundamental principles upon which all permanent molds are operated form the subject of a patent taken out by Szekely Jan. 15, 1907. One of the molds is shown in the accompanying illustrations, Figs. 8 to 11. A plan of the closed mold in seven parts is shown in Fig. 8, an end view is shown in Fig. 9. Fig. 10 is a front elevation as seen from the left of Fig. 9 and Fig. 11 is a plan showing the mold thrown open. One of the castings produced in the mold is shown at *C* Fig. 11. The mold is made up of a base 1, movable sides 2 2, movable ends 3 3 and movable top plates 4 4. The sides slide on the base and are actuated by screws 5 rotatable in nut bearings 6 on the base and controlled by the hand wheels 7. The ends are pushed back and forth in a similar manner. The top plates are hinged to the sides. When they are in place they are locked by the bolts 11 hinged to the ends and engaging slotted lugs 12 on one of the plates 4. An outlet 14 is shown in one of the top plates for a vent channel.

The mold shown in Figs. 8 to 11 inclusive is for a rather irregular, intricate and hollow pump section in cast iron or steel. The mold is opened immediately after the casting shell has frozen sufficiently to retain its shape. The surface of the mold is covered with a suitable wash and a sand core is employed to form the interior. A collapsible steel core might be adapted for the purpose.

Different Types of Molds

Molds may be entirely hand operated, semi-automatic or automatic, where practically every movement in opening and closing the mold is controlled by automatically operated mechanical devices. Usually cores are set by hand but in molds designed for pipe fittings they may be inserted and withdrawn mechanically.[21] The mold cavity necessarily must be larger than the proposed casting to provide for contraction and the exact contraction allowance provided will depend on the metal or alloy from which the castings are to be poured. The shape of the casting and its size together with the shape and size of the necessary cores determine to some extent the most suitable form of permanent mold to employ. In a general manner it may be stated that practically all permanent molds may be divided into four groups.

In the first the mold body proper is constructed of two halves or of several sections mounted on a base. The halves may be hinged or one half may move straight forward and backward on suitable slides. A mold made up of several sections mounted on a base is shown in Fig. 12 where the mold is assembled ready for the metal. The same mold with the various sections removed for the ejection of the casting is shown in Fig. 13. This particular mold is used in a French foundry for casting dynamo-starter castings in an aluminum alloy.[22]

In the second type of mold the body proper in two halves, slides on a flat base. The two halves contain the entire mold cavity. The halves are actuated by suitable levers and when closed are held in alignment by dowel pins or by a clamp and lock. The halves may be hinged together or they may be mounted on a track. The hinged type is the more common. The mold and gate cavities may be cut partly in each half or all in one half. With the hinged type a smooth base surface is required. Where a track is provided the mold may be operated on a rack or through a lead screw similar to that of a vise.

An English Mold

Details of a mold of the second type are shown in Fig. 14. This mold was employed in an English plant during the recent war for casting aluminum alloy packing pieces for airplane struts. The mold is made up of the two halves 1 1, doweled together and hinged around the stud 7 fixed to the base 3. The mold cavity occupies space in both halves of the mold and the two inserts 4 4 fill the planed slots as shown in the sectional view X X to the left of the illustration. The inserts are held by screws not shown. Runner blocks 2 2 are screwed to the top of the mold. The core 5 forms the slot in the casting. It is riveted to lever 10 which moves on fulcrum 9 and raises and lowers the core. When in position the core 5 is retained by the pin 11. The two handles 12 12 are for opening and closing the mold. The casting is shown in the upper corner right.

Another mold of the second type[23] is shown in detail in Fig. 15. This machine also was used in England for casting small gear wheels in a zinc-base alloy, but the same machine might be utilized on aluminum alloys. The mold is made up of two parts 1 1 fitted with handles and hinged to the stud 5, screwed to the base 3. The two runner blocks for the upper end of the wheel hub and are held in place by the pin 6. The ring 4 is set in the base plate and forms the teeth. The lower hub is formed in the base plate. The four core pins 7 and the single core pin 8 slide up and down in parts 2 and 3.

In the third type of mold the body in two parts is mounted on a vertical arm in manner that permits one half to swing to and fro. Molds of this type have been developed by Custer for making soil pipe fittings. (See former reference 21.)

Molds in Batteries

In the fourth type of mold one half of the body is fixed on a suitable base and the other half is opened and closed mechanically. The mold may be operated individually, but usually it is set up as a unit of a battery on a revolving table where the pouring operator remains stationary and the molds pass in turn at a predetermined speed. This arrangement is shown in Moldenke's paper describing the practice at the plant of the Holley Carburetor Co., Detroit, and read last year at the meeting of the American Foundrymen's association in Cleveland. It was published in THE FOUNDRY, May 15, 1923 and also in the *Transactions*. A sand core is employed. The molds open automatically at a definite point past the pouring station, the castings are ejected and the molds are again closed automatically before they arrive in front of the ladle.

More elaborate permanent molds with two or more partings and intricate coring devices are required for large and complicated castings. Usually this type of mold is mounted on a heavy base plate and rides on tracks. The movable sections are actuated by long screws. Two or more operators may be required on large molds, but one man usually is able to operate a small mold.

While mention has not been made of plaster of Paris molds, a word in passing may not be out of place. These molds are used to some extent for producing brass castings in which a fine surface is of paramount importance.[24] Castings poured in these molds frequently are referred to as permanent mold castings on account of the surface appearance, but the term is incorrect and should not be applied. Composition of the materials used for molds and mold linings will be considered in the second part of this paper which will be published in an early number.

The Cleveland Stone Co., Cleveland, which recently acquired the Sterling Grinding Wheel Co., has developed a new wheel especially designed for aluminum grinding.

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21. Anonymous. A Sandless Iron Foundry. *Iron Trade Review*, Vol. 46, 1910, pages 304-315.

22. Guillot, L. Description de Quelques Coquilles de Moulage Utilisees Pour l'Aluminum et Ses Alliages, Reveue de Metallurgique, Vol. 18, 1921, pages 512-516 and Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, Vol. 133, pages 756-762.

23. Anonymous. Dies for Hand Poured Die Castings. *Metal Industry*, (London), Vol. 19, 1921, pages 41-44, 97-99, 126-131.

24. Gleason, E. D. Permanent Molds. *Metal Industry*, New York, Vol. 19, 1921, pages 391-393.

Welds Iron Pipe With Bronze

Only Moderate Temperatures Are Required In Welding Cast Iron Pipe With Tobin Bronze—High Corrosive Resistance Of These Two Metals Owing To Structural Formations Described

BY H. Y. CARSON

TO COMBAT loss of gas from distribution mains and services, gas engineers have been interested in a method or process of construction which would produce joints as efficient and tight as the pipe.

Research on the bronze welding of cast-iron pipe has brought new ideas to bear on this subject. Of course other joints will, not be displaced entirely, but the art of making welded joints in cast-iron pipe would be a great help toward economy and better engineering practice.

Among the earliest pipe lines constructed, cast iron pipe has a most satisfactory history because some of the first cast-iron pipe ever laid under ground is still in service after more than 200 years. In this country at the present time there are some 125,000 miles or more of cast-iron pipe in use. Carrying fluids such as water and oil, as well as gas for heating purposes, etc. The replacement due to all forms of corrosion is practically negligible. There are acid conditions and severe corrosion conditions where even cast iron will suffer after long service, but usually it is as satisfactory as other pipe materials used.

A wide difference exists in the methods for making pipe and it is just this difference which explains the variation in the lasting qualities. Wrought iron steel and cast iron pipe all are derived from pig iron, but in the case of steel or wrought iron nearly all of the carbon must be removed before the material can be put through the rolling mill and converted into pipe.

Ordinary gray iron contains 3 per cent or more of carbon, which causes fluidity of the iron and enables it to be cast successfully into molds. When the iron sets under normal conditions in a mold the crystals formed cement themselves together in an irregular orientation with respect to the surface of the casting. While it may be possible for rust to penetrate the cast iron through porous fissures, yet the irregularity of the structure acts as a barrier to continuous rust action because after the rust has penetrated into such a structure, it cannot force the crystals apart. The rust may, after first filling up the outer pores, act as protective film against further action. It has been observed that if a strong acid is used to dissolve this outside rust coating, corrosion can go on if the rust is repeatedly removed.

Describes Crystallization

In steel or wrought iron pipe, the crystals are torn apart and broken up to a certain extent and are aligned more or less parallel to the surface. Some of the crystals upon being torn or sheared apart while passing through the heavy rolls have open edges exposed at a slight angle to the surface of the finished pipe. It is at these particular areas on the surface where pit holes begin and run rapidly into

Similar Metals Used

STRIKING similarity will be noted in the brazing metal used namely tobin bronze, and the low temperatures recorded in welding cast iron pipe in this article and one written by A. H. Jasson, published in THE FOUNDRY, *June 1 issue entitled "Describes Welding Process." In both discussions the welding temperatures recorded are approximately the same,* 1450 *to* 1700 *degrees Fahr. These low temperatures have the advantage of preventing excessive oxidation at the weld which might be detrimental to the strength of the parts welded.*

In the method developed by Mr. Carson an ordinary welding rod of tobin bronze is used, the joint being preheated by playing an oxy-acetylene flame back and forth transversely across the joint area. The bronze rod is melted and allowed to flow along the joint spreading about one inch in width entirely around the pipe.

Abstracted from a paper presented at the Cleveland meeting of the Natural Gas Association of America. The author is research engineer of the American Cast Iron Pipe Co., Birmingham.

FIG. 1—WELDING CAST IRON PIPE WITH TOBIN BRONZE BY OXY-ACETYLENE FLAME. FIG. 2—SECTION OF WELDED CAST IRON PIPE READY FOR LAYING

or through the section of the pipe.

Cast iron pipe has been welded successfully using tobin bronze. As to the tobin bronze used in the bronze welding process, the effect of corrosion is almost nil. Similarly, this bronze will coat itself with a greenish oxide and being likewise of a cast crystalline structure, its life will equal that of cast iron when exposed underground. This bronze is also of high tensile strength.

Tests and experiments conducted at the plant of the American Cast Iron Pipe Co., Birmingham, on bronze-welded, cast iron pipe showed the average strength of a well-made bronze welded joint on 6 inch cast-iron pipe to be 68,333 pounds per square inch of bronze section. Tests of the cast iron pipe showed it to have an average strength of 22,631 pounds per square inch. The conclusion from these tests was that tobin bronze has three times the tensile strength of cast iron and consequently needs to be only 1/3 as thick as the pipe. In smaller diameter pipes it was found to be an advantage to apply the bronze over the outside surfaces and make the total width of the weld three times as thick as the pipe.

In view of the tests mentioned and experience, the writer formulates the rule of making bronze welds 1/3 as thick as the pipe and three times as wide as the pipe is thick. This leads to a simple formula for computing the weight of bronze required per joint.

$$W = 0.9425\ t^2\ (D + 3t).$$

Where W equals weight of tobin bronze in pounds.

Where t equals thickness of pipe in inches,

Where D equals nominal diameter of pipe in inches.

The formula holds good for all sizes of cast-iron pipe from 2 inches to 24 inches. In larger sizes the problem of applying welded joints has not been experimented on sufficiently to determine just what new factors, if any, are involved.

Welding Temperatures Recorded

One of the important features relating to a thorough knowledge of bronze welding cast iron pipe is an understanding of the effective temperatures at which the welding takes place. In the case of welding ordinary steel pipe the temperature must be raised to something around 2600 degrees Fahr. to 2800 degrees Fahr., whereas in bronze welding cast iron pipe a temperature ranging from 1450 degrees Fahr. to 1650 degrees Fahr is about correct. This is an important element insofar as the structure of the cast iron material is concerned. If high temperatures are applied to cast iron,the internal structure is somewhat changed, owing to the graphitic carbon changes its form at temperatures above 1750 degrees Fahr. These higher temperatures have two effects, first, weakening the cast iron, and second, causing the graphitic carbon to burn or oxidize, and thereby setting up a retarding action against the bronze at the surface of the pipe. This retardation of the welding at the higher temperatures is an important element to keep in mind if satisfactory bronze welded joints are to be made.

The development of bronze welding cast iron pipe will undoubtedly prove a boom to the gas engineer, because it will enable him to design his distribution system with complete cast iron construction throughout. Fittings can be made of the same material as the pipe line, in fact fittings may be made from the odd pieces of cast iron pipe which are ordinarily left over from the pipe laying jobs, and these odd pieces can be worked up in the shop into suitable fittings at a great saving to the gas company. Bronze welding has many other applications than those mentioned in this paper, and it is quite probable that in the future a bronze weld may be prepared on the ends of pipe coming from the foundry, so that still further reductions in the cost of laying lines may be obtained by having a part of the field work transferred to the factory where it can be more efficiently and less costly done.

Reports on Sand Reclamation Tests

AT A MEETING of the joint molding sand research executive committee of the American Foundrymen's association, held recently, A. A. Grubb, Ohio Brass Co., Mansfield, O., presented a progress report of the subcommittee on reclamation and conservation. The work accomplished to this time was reported previously at the Cleveland convention of the association, May, 1, 1923, so that this report outlines the developments since that date.

Steps first were taken to set up test equipment that would give data comparable with the data obtained by other investigators. A standard cohesiveness test apparatus was constructed and a standard rammer for the permeability test was made. The former was not completed until late in the summer but now is in regular use.

The experimental floors Nos. 1 and 2, using reclaimed sand, as described in the previous report, have been continued in regular use. Along with them another floor, No. 4, using Albany sands has been observed. This was done for purposes of comparison. In May these floors were put under more careful observation than previously. Each floor was swept every morning and the sweepings were put through screens to remove cores and brass spillings and then weighed. Additions to heaps were determined by tests for bond, permeability and fineness and were weighed in. A complete record was made of sweepings recovered and additions made to each heap. The sweepings were low in bond and a little coarser than the heap sand, so finer and higher bonded sand, Nickleplate No. 1, was used to rebond it. The proportions, indicated by tests on the heap and its working properties, were measured into a mixer manufactured by the National Engineering Co., Chciago. Water was added to the proper temper and the mixture was mulled for about 10 minutes. It then was dumped on the molding floor with the rest of the heap and mixed in by cutting with a shovel. The floors were swept each morning but additions to the molding sand were found necessary only about once a week. Observations in this manner were continued over a period of 10 weeks and averages then were taken. Experimental floor No. 1 produced 264 pounds of swepings per week. All these sweepings and 68 pounds from other floors, a total of 332 pounds, were rebonded by the addition of 297 pounds of new bonding sand and returned to the floor. Three hundred and sixty-five pounds of sand were lost from this heap each week, most of it probably being carried away on the castings. New sand added to this heap cost $0.394 per week.

Floor No. 2 produced 261 pounds of sweepings per week; 257 pounds of these sweepings were rebonded by the addition of 229 pounds of new bonding sand and returned to the floor; 225 pounds of sand were lost from this heap each week. New sand added cost $0.304 per week.

The Albany heap on floor No. 4 required the addition of 466 pounds of Albany sand per week. An equal quantity of sand was lost in sweepings and carried away. The new sand which was added to this heap cost $1.20 per week.

There was a saving of between 80 and 90 cents per heap per week accomplished by reclaiming the refuse sand. This did not include cost of labor and overhead on the machine used, because a small unit was used and so more labor was required than would have been necessary with a machine of larger capacity. Even with this small outfit the cost of mulling the recovered sand did not exceed 30 cents per week.

During the period of this test the following characteristics were maintained as near as possible in the heaps:

Permeability, 20—25; bond, 2.50—2.75 inches; 160—180 A. F. A. Method. Fineness of grain, 130—140; Clay substance, 6—8 per cent.

The dye absorption determination was made during the early part of the test, but was discontinued early in August. It was felt that it was not giving valuable information. The figures ranged from 0.06 to 0.08 per cent.

The working qualities of the sand varied not only with its physical characteristics, but also with the type of job that was being made. No preference was shown the experimental floors as regards assignment of jobs, difficult jobs as well as easy ones being made. Some jobs required bond of 2.70 to 2.80 inches, 175 to 185 A. F. A., while others worked well on bond values considerably lower. Permeability values less than 20 were apt to result in blown or misrun castings on most of our jobs, while some few required values above 25. Temper was found to be an important factor and a most difficult one to control. Moisture determinations were made daily on the heaps for a period of several weeks and the molders were informed of the results. Some improvement resulted, but it is doubtful if the improvement was commensurate with the labor involved.

Serious trouble was experienced throughout the tests due to prejudices on the part of the molders and their instructors. Much of this prejudice was no doubt entirely unintentional, but men who have used nothing but Albany sand for years and have had additions of this new sand made whenever they wished, found it easy to blame their troubles on the recovered sand. Consequently, numerous false alarms developed.

At the conclusion of the 10 weeks' test considerable difference of opinion existed as to the value of the reclaimed sand. It generally was agreed that when the heaps are in good condition, properly controlled as to bond, permeability, etc., they worked as well as the Albany heaps. It was believed by some, however, that the reclaimed sand burned out more easily than the Albany heaps. The foreman felt that the reclaimed sand was more sensitive and more apt to go wrong if not properly cared for.

To get more definite data on the comparative working properties of the two heaps, one composed entirely of reclaimed sand and the other of Albany sand, the following test was made:

A floor was arranged to accommodate two small heaps of sand. Molds were made alternately from reclaimed sand and from Albany. Each lift was graded and recorded as follows:

1. Perfect or nearly perfect lift.
2. Fairly good lift, edges rather rough.
3. Sand sticks to plate at a few points.
4. Sand sticks badly.
5. Sand falls in. A drop.

Lifts graded as 1 and 2 only were accepted and used in making up the mold; grades 3, 4 and 5 were recorded, but thrown out. Metal was then poured in the molds, the castings were shaken out and inspected. Record was made of their conditions. Bond, permeability and moisture determinations were made daily, but no additions were made to the heaps, as it was the purpose to observe relative rates of deterioration. Six hundred and twenty-five pounds of reclaimed sand and an equal quantity of used sand from an Albany heap that was in excellent working condition were put on the floor to start with. Table I contains the results of the tests covering six days of work. The fourth column gives the average grade of the lifts.

Thirty-eight molds were made and poured in each heap. Considerable sand from each heap fell under the machine and became mixed, so that it could not be returned to the heaps. This reduced the size of the heaps so rapidly that the test had to be discontinued at this point. There was no apparent deterioration in the working qualities of the sand or in its physical characteristics as measured by the tests. The lift grades indicate that the reclaimed sand worked as well as the Albany sand.

The comparison test was started again on October 1, this time with 785 pounds of sand in each heap. Unfortunately, the sand being used, Albany No. 1, was very coarse, so the Albany sand used in this test was more open than the reclaimed sand when built to the same bond. At this time we also used the A. F. A. method for the bond test. To conserve the quantity of sand, three molds were made from each heap alternately, but the floor was swept and the sand returned to the proper heap after each three molds. No rebuild has been added, as we are hoping to burn out the sand heaps. Table II is a record of the data obtained to date.

One hundred and eight molds have been made and poured in each heap, but both are working well. The bond has decreased a little, but there has been an increase in the permeability of each heap. In the early part of the experiment the Albany heap sand gave better lifts than the reclaimed sand, the average grades for the first 10 days being 1.52 for the reclaimed sand and 1.33 for the Albany sand. The last nine days the reclaimed sand has given a better average than the Albany, 1.21 against 1.31. The investigators are at a loss to account for this. They also are unable to explain the improvement noted in both heaps unless attributed it to improvement in the ability of the operator. This is possible, as he had had experience as a molder.

It is evident that the reclaimed sand compares favorably with the Albany heap sand in working qualities. Further than this, no attempt is made to draw conclusions until further work has been done on the two heaps under our present close observation.

Sand Reclamation Test

TABLE I

Sand Reclamation Test

Date	Bond	Perm.	Mois.	Av. lift
	Albany Sand			
9-19	2.82	20.0	7.7	1.65
20	2.77	20.8	6.6	1.58
21	2.74	20.0	6.6	2.00
25	2.64	20.3	7.1	2.27
26	2.73	20.0	7.4	2.00
28	2.77	21.3	6.9	1.20
Averages	2.74	20.4	7.0	1.78
	Reclaimed Sand			
9-19	2.80	20.6	7.9	1.61
20	2.73	19.9	7.1	1.68
21	2.82	23.2	7.0	1.93
25	2.78	18.8	6.6	2.15
26	2.77	20.7	6.6	2.00
28	2.80	19.0	6.2	1.36
Averages	2.76	20.4	6.9	1.79

TABLE II

Reclaimed Sand

Date	Bond	Perm.	Mois.	Lift
10- 1	194	g.21.2	6.2	1.37
5	173	18.8	7.5	1.41
8	184	20.3	6.4	1.63
9	169	18.8	6.7	1.58
10	176	18.0	6.5	1.50
11	178	18.5	7.2	2.06
12	175	18.2	7.5	1.69
15	168	23.7	7.9	1.38
16	169	25.4	7.6	1.35
17	163	23.9	7.7	1.23
18	167	19.8	7.8	1.46
19	171	22.0	7.0	1.08
22	183	22.2	6.5	1.63
25	168	25.5	7.1	1.08
23	163	23.6	7.7	1.16
24	164	24.3	7.3	1.16
26	166	23.7	7.3	1.28
29	179	27.6	6.4	1.00
30	168	22.8	7.2	1.00
	Albany Heap Sand			
10- 1	191	g.25.5	6.4	1.37
5	180	27.8	6.9	1.17
8	164	25.1	7.9	1.18
9	171	23.7	6.9	1.66
10	173	26.2	6.9	1.56
11	182	23.7	6.6	1.66
12	168	22.3	8.1	1.14
15	167	33.5	7.3	1.42
16	169	35.0	7.2	1.16
17	159	30.2	8.0	1.00
18	164	27.9	7.7	1.61
19	168	23.4	6.7	1.16
22	180	29.5	6.4	1.66
23	168	32.6	7.1	1.78
24	177	28.8	5.8	1.33
25	174	30.1	5.9	1.03
26	178	30.7	5.9	1.15
29	171	33.5	6.0	1.00
30	166	33.2	6.6	1.00

Use Oil in Malleable Furnace

New Method Installed When Costs Become Prohibitive—Use Same Construction as Was Employed in Coal Fired Furnace—Oil Consumption Is Considered Low

BY B. R. MAYNE AND CARL JOSEPH

NUMEROUS conditions must be considered carefully in selecting a fuel for malleable iron furnaces. The various kinds of fuel all have their places, depending on location, local conditions, investment, etc. In some plants employing hand firing methods there has been discussion concerning the advisability of changing to fuel oil. The change usually is simple and it is thought that once the change is made and given a fair trial, the results will be gratifying.

There always has been some question in the minds of foundrymen regarding the increase in the cost of melting with fuel oil over the hand firing method. Oil has been used for melting since 1919 at the Saginaw Malleable Iron Co., Saginaw, Mich. The oil burning equipment was installed at that time since it was possible to obtain coal only at an exorbitant price and labor was scarce. At the Saginaw plant the heats are large and it was difficult to melt them satisfactory. This obstacle has been overcome with the use of fuel oil, and now the size of the heat does not give any trouble. Taking into account the cost of fuel labor difficulties and the ease of manipulation, oil firing is preferred by the Saginaw company over hand firing with coal. During the past year, hand firing with coal in the annealing ovens has been changed to oil firing and satisfactory results have been obtained. The continuous tunnel type kiln has been operated on oil during the past four years.

The construction of the present oil furnace is the same as that used for coal firing. Figs. 1 and 2 show the melting furnace in detail. The combustion chamber was built over the old firebox, using sand and old fire brick to fill over the old grates. The two inner walls were built to form a V-shaped combustion chamber 8 feet long and 18 inches apart at the burner end and spreading to the width of the furnace just ahead of the front bridge wall. The burner was placed in front of the combustion chamber and was inclined slightly toward the bath.

The furnaces have been enlarged recently to take care of the increase in production. On one furnace in which a maximum of 26 tons formerly was charged, the combustion chamber was moved out 6 feet. The largest heat melted in this furnace is 38 tons. On two other furnaces in which a maximum of 26 tons formerly was charged, the rear bridge was moved back, so that 30-ton heats are melted regularly. This gives a maximum melt for four furnaces of 125 tons per heat, or 250 tons per day.

The opening over the rear bridge wall is adjusted to give the proper velocity for the gases. It has been found that too large an opening causes an excessive draft, which oxidizes more than the usual amounts of the elements. The bridge wall opening is from 10 to 12 inches on two furnaces. The other two have a 250-horsepower waste heat boiler attached, which is used alter-

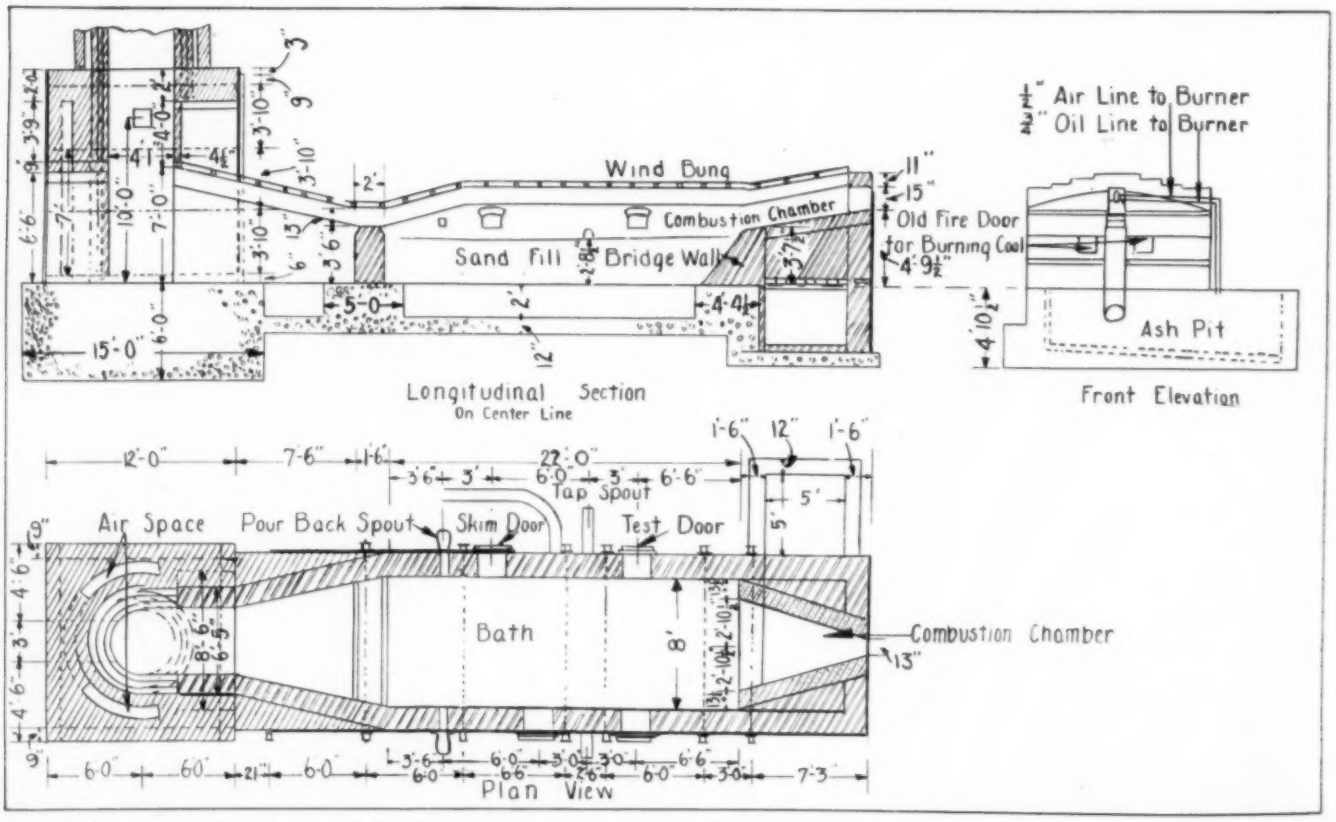


FIG. 1—TOP—LONGITUDINAL SECTION OF THE OIL BURNING MELTING FURNACE FIG. 2—BELOW— PLAN VIEW OF THE FURNACE

DETERMINATION OF MANGANESE IN IRON

DESHAY'S METHOD

This rapid and accurate method may be applied to plain carbon steel as well as cast iron and is based on the fact that manganese nitrate when boiled with an excess of nitric acid and lead peroxide is oxidized to permanganic acid which is reduced by a standard solution of sodium arsenite.

Solutions Required

Nitric Acid—Chemically pure nitric acid, specific gravity 1.42, mixed with an equal volume of distilled water gives the acid of 1.20 specific gravity used to dissolve the iron and steel.

Stock Sodium Arsenite—To 150 cubic centimeters of distilled water add 15 grams of arsenious acid and 45 grams of sodium carbonate. Heat until the arsenious acid and sodium are dissolved. Cool the solution and make up to 1000 cubic centimeters with distilled water.

Standard Sodium Arsenite—Dilute 300 cubic centimeters of the stock solution to 1000 cubic centimeters with distilled water. To standardize this solution a steel or cast iron containing a known amount of manganese is treated exactly as described under the head of method. Divide the per cent of the known manganese in the steel or cast iron by the number of cubic centimeters of the standard solution required to decolorize the permanganic acid. This will give the value of each cubic centimeter of the standard solution in terms of manganese. For example: Amount of standard iron used 0.2 grams—Burette reading shows 8 cubic centimeters standard solution used—the standard iron contains 0.56 per cent of manganese, therefore 8 cubic centimeters equals 0.56 per cent manganese and 1 cubic centimeter equals $\frac{0.56}{8}$ or 0.07 per cent which is the factor.

Method Used

Dissolve 0.20 grams of steel or cast iron in 30 cubic centimeters of nitric acid, specific gravity 1.20, using a 1 x 12 inch test tube for the purpose and boil until reaction ceases. Add cautiously 2 grams of lead peroxide or red lead and boil for two or three minutes. Cool the test tube in running water and allow the lead salt to settle, hastened by the use of a centrifugal machine if necessary. Decant the clear liquid into a 100 cubic centimeter Erlenmeyer flask and titrate immediately with the standard sodium arsenite solution until the disappearance of the pink color to light amber.

Notes

For samples containing up to 1.50 per cent of manganese use 0.2 grams and for samples containing over 1.50 per cent use half the amount of 0.10 per cent, changing the value of the factor accordingly.

DETERMINATION OF SULPHUR IN COKE

FUSION METHOD WITH SODIUM PEROXIDE

The following method affords a rapid and accurate means for finding the sulphur in coke.

Apparatus

Crucible—A nickel or soft steel crucible of about 50 cubic centimeter capacity is used, the lid being perforated with a small hole of sufficient size to permit the introduction of the ignition wire.

Crucible Stand—Any suitable arrangement for holding the crucible firmly in place and out of contact with the beaker during the combustion process is satisfactory.

Method Used

To the dry crucible, first add 12 grams of pure dry sodium peroxide and 0.7 grams of coke in a finely powdered state (80 mesh) and mix thoroughly and as rapidly as possible with a small porcelain spatula. Place the covered crucible on its stand in a 20-ounce beaker containing sufficient cold water to cover the lower half of the crucible.

Ignite the contents of the crucible by thrusting a red hot wire through the small hole in the lid. Wait two or more minutes for the fused mass to cool, then remove the stand and tip the crucible over on its side in the water. After the fusion dissolves rinse and remove the crucible.

Acidify the solution with hydrochloric acid (1-1 solution) in slight excess. Care must be exercised in adding the acid to avoid excessive foaming. Filter and wash. To the filtrate add a drop of methyl orange and hydrochloric acid if necessary to keep the filtrate mildly acid. Bring to boiling and add drop by drop 10 cubic centimeters of concentrated barium chloride solution. Continue a gentle boiling until the precipitate shows granular. Allow to settle. Filter. Wash with distilled water until the silver nitrate test shows no chlorides. Ignite and weigh the precipitate as barium sulphite.

Formula

Grams $BaSO_4 \times 0.13734 =$ per cent sulphur.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, JUNE 15, 1924
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

WHITEHEAD'S SANDS

Whitehead Brothers Company

ESTABLISHED 1850

Foundry Sands, Supplies and Equipment

Providence, R. I. June 7, 1923.

John A. Penton, Esquire,
The Foundry,
Cleveland, Ohio.

Dear Mr. Penton:

We select THE FOUNDRY as an advertising medium because it is preeminently the periodical of the foundry industry and world wide in scope. This makes it of considerable advantage in the presentation of our products and keeping the name WHITEHEAD before the trade.

Our advertisements have appeared regularly for many years. In fact since the early issues and it is a pleasure to state that during that time the service rendered and co-operation shown have been most satisfactory. You, and the officers of the Company, have assisted in making our subject matter of value.

We take pride, Mr. Penton, in having been identified with the growth of the publication and in telling you so.

With assurances of continued patronage, we remain

Very truly yours,

WHITEHEAD BROTHERS COMPANY

Alfred J. Miller
Treasurer.

AJM/I

Table I

Results Obtained on Two Furnaces

Furnace No. 3

Date		Charge in tons	Fire started	Heat tapped	Heat out	Total oil in gallons	Gallons ton	Minutes per ton until tap
10/ 1	a.m.	20	1:00	8:24	9:20	1466	73.3*	22.2
10/ 1	p.m.	20	10:05	4:18	5:25	1236	61.8	18.6
10/ 2	a.m.	23	12:30	8:06	9:05	1357	60.7	19.8
10/ 2	p.m.	24	9:40	4:18	5:24	1200	50.	16.6
10/ 3	a.m.	25	12:00	8:00	9:08	1518	60.7	19.2
10/ 3	p.m.	24	9:40	5:06	6:20	1288	53.7	18.6
10/ 4	a.m.	25	12:00	8:12	9:18	1415	56.6	19.6
10/ 4	p.m.	23	10:00	4:54	5:54	1133	49.2	18.0
10/ 5	a.m.	25	12:00	8:00	9:15	1474	59.0	19.2
10/ 5	p.m.	26	10:00	4:48	6:15	1294	49.8	15.7
10/ 6	a.m.	27	2:30	11:05	12:15	1512	56.0	19.0
10/ 8	a.m.	21	12:00	8:30	9:55	1572	74.8*	24.3
10/ 8	p.m.	18	10:25	4:48	6:00	1152	64.0	21.2
10/ 9	a.m.	25	12:00	8:00	9:14	1334	53.3	19.2
10/ 9	p.m.	22	9:45	4:00	5:06	1152	52.3	15.0
10/10	a.m.	25	12:00	8:00	9:10	1346	53.8	19.2
10/10	p.m.	25	9:50	4:36	6:00	1210	48.4	16.2
10/11	a.m.	26	11:45	8:12	9:32	1436	55.2	19.5
10/11	p.m.	23	10:10	4:48	5:50	1204	52.3	17.3
10/12	a.m.	26	11:30	8:00	9:25	1466	55.2	19.6
10/12	p.m.	23	10:25	5:00	6:15	1260	54.7	17.1
10/13	a.m.	25	11:30	8:42	9:53	1488	59.5	22.0
10/15	a.m.	21	12:00	8:30	9:25	1538	73.2*	24.3
10/15	p.m.	19	10:00	4:36	5:30	1210	63.7	20.8
				Furnace No. 4				
10/ 1	a.m.	20	11:00	6:30	7:30	1613	80.6*	22.5
10/ 1	p.m.	25	8:30	2:30	3:50	1412	56.5	14.3
10/ 2	a.m.	25	10:00	6:30	7:40	1693	77.0	20.4
10/ 2	p.m.	27	8:30	2:48	4:12	1416	52.4	14.0
10/ 3	a.m.	27	9:15	6:30	7:40	1856	68.7	20.5
10/ 3	p.m.	29	8:35	3:18	4:50	1577	54.7	14.0
10/ 4	a.m.	30	8:30	6:30	7:50	1896	63.2	20.0
10/ 4	p.m.	27	8:45	3:30	4:48	1460	54.0	15.0
10/ 5	a.m.	30	8:30	6:30	7:45	1757	58.5	20.0
10/ 5	p.m.	29	8:35	3:12	4:36	1548	53.3	13.7
10/ 6	a.m.	35	7:30	6:30	8:05	2070	59.1	18.8
10/ 8	a.m.	23	10:30	6:54	8:15	1842	80.0*	22.0
10/ 8	p.m.	23	9:00	3:24	4:41	1503	65.3	16.7
10/ 9	a.m.	27	10:34	6:34	7:42	1779	65.8	17.7
10/ 9	p.m.	26	8:20	2:30	4:00	1554	59.7	13.8
10/10	a.m.	30	9:00	6:30	7:45	1872	62.4	19.3
10/10	p.m.	27	8:30	3:06	4:36	1642	60.7	14.6
10/11	a.m.	31	8:45	6:30	8:00	1893	61.0	18.8
10/11	p.m.	25	8:50	2:54	4:30	1515	60.6	14.5
10/12	a.m.	31	8:45	6:30	7:48	1966	63.4	18.9
10/12	p.m.	26	8:40	3:00	4:45	1600	61.5	14.6
10/13	a.m.	32	8:70	6:30	7:55	2032	63.5	18.7
10/13	p.m.	18	8:40	1:18	2:12	1158	64.3	15.4
10/15	a.m.	23	10:00	6:30	7:40	1606	69.8*	22.1
10/15	p.m.	22	8:15	2:25	3:25	1320	60.0	16.8

*Monday morning.

nately. The bridge wall opening on the one using the boiler is from 16 to 20 inches. The furnace stacks are 75 feet, high and the two waste heat boiler stacks are 125 feet high. The draft on the furnace to which the boiler is attached can be regulated by a damper on the top of the stack.

The burner used on all furnaces is made by the W. N. Best, Inc., New York. Each furnace is equipped with one burner of the fan tail type. The oil enters the burner through a ¾-inch line at about 40 pounds pressure, and is cut off perpendicularly by compressed air which enters the burner through a ½-inch line at 80 pounds pressure.

The burners are cleaned occasionally to remove carbon deposits at the orifices. Steam at 30 to 75 pounds pressure has been tried several times for atomizing the oil, but the time of melting was increased, with a considerable greater oxidation loss. Air is admitted through a 16-inch pipe under the burner at a fairly low pressure. The top blast is taken off this 16-inch pipe at four different places through 3-inch pipes at the center of the furnace 6 inches apart. In coal firing, six and eight top blast openings were used, but in oil firing this number of openings seemed to burn the side walls excessively. Therefore, the number has been reduced. Fig. 3 shows the wind bung block used at the present time. The wind bung is 18 inches wide. Fig. 4 shows the tap hole block used, which has proved satisfactory.

Pipes Heated by Steam

The oil is pumped from storage tanks of 16,000 and 20,000 gallon capacity though a strainer into the 3-inch main line to a meter. From the meter to the valve pressure regulator, the line is reduced to 1½ inches and then to ¾ inch to the burner. By passing steam through the coils in the tanks in sufficient time before using, the temperature of the oil is kept around 120 degrees Fahr., which gives a temperature of about 100 degrees Fahr. at the burner. An oil preheater is being installed at each furnace to heat the oil and maintain the temperature at about 135 degrees Fahr. This is necessary during cold weather, as it has been found that when the temperature of oil falls around 90 degrees or under, trouble is experienced at the burner. Oil pressure at the pumps is maintained at 55 to 60 pounds. The pressure is held as uniform as possible throughout the heat.

At each furnace is an oil and air pressure gage which is found useful in case of trouble. Enough oil is analyzed to keep a close watch on the

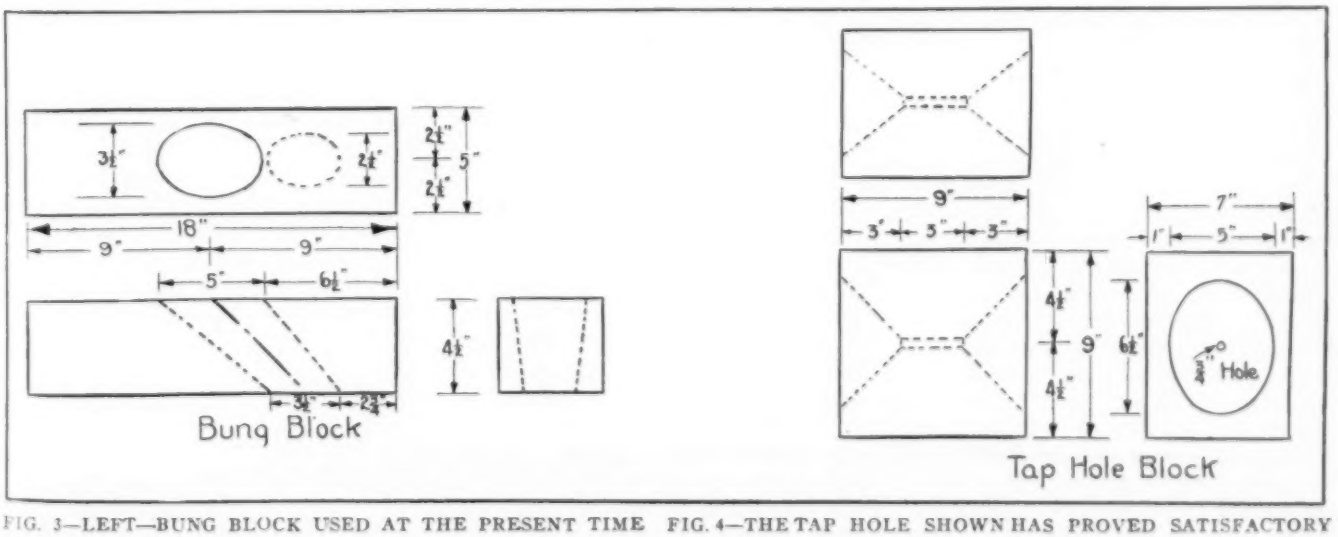


FIG. 3—LEFT—BUNG BLOCK USED AT THE PRESENT TIME FIG. 4—THE TAP HOLE SHOWN HAS PROVED SATISFACTORY

quality received at the plant. Oil of the following specifications is desirable:

Specific gravity	0.87 to 0.89
Flash point	Greater than 150 degrees Fahr.
Viscosity	Less than 200 seconds
Pour test	Summer; not over 45 degrees Fahr. Winter; not over 20 degrees Fahr.
Sulphur	Less than 1 per cent
Water and sediment	Less than 2 per cent

Oil and production records during the past few months have shown up well, and an idea of what may be expected from oil fired air furnaces is shown below:

	Aug., 1923	Oct., 1923
Total melt for month	5065.5 tons	5141 tons
Average melt per day	202.6 tons	205.6 tons
Average melt per heat	24.8 tons	25.2 tons
Total number of heats per month	204	204
Oil used during month; actual tank measurements	308,373 gals.	316,859 gals.
Average gallons per ton melt for month	60.87 gals.	61.63 gals.
Total oil used Aug. 16 to 31	164,862 gals.	
Average per ton for this period	59.46 gals.	
Number of heats for this period	106	
Melt for week ending Sept. 1	1204.5 tons	
Average melt per day	219 tons	
Average melt per heat	27.3 tons	
Number of heats	44	

The oil consumption per ton of iron melted is considered low. A large number of afternoon heats have been melted on less than 50 gallons per ton, and morning heats on less than 60 gallons per ton. The best oil consumption is obtained when the heats are near the normal capacity of the furnace. If too large a charge is melted, the time required to get the fire through the furnace, and superheat the charge, is increased abnormally, thus raising the oil consumption.

The accompanying table shows the average results of two different furnaces, and indicates what may be expected in regular production. Pouring iron from these two furnaces is handled by the same pouring gang. Furnace No. 4 was poured first. A rest period of 15 to 20 minutes usually is given between the pouring of the heats. In some cases the iron in furnace No. 3 was hot and ready to pour 30 minutes or more before the heat was tapped, and had to be held until the other heat was out. This has increased the time on furnace No. 3 under the column "minutes per ton until tapped."

The charge is brought to the furnace on trucks, which also are used as charging boxes. These trucks have lugs at each end on which a chain from the overhead electric traveling crane is fastened. The crane raises the truck over the top of the furnace and a tripping device dumps the charge. It takes from 30 to 40 minutes to charge 25 tons in the furnace.

The proper placing of the charge in the furnace is of great importance. The sprue and hard iron scrap are charged as near to the front as possible, leaving enough room in the front for malleable scrap, steel and a small amount of pig iron on top. The balance of the pig iron is placed back of the sprue. The charge should be put in the center toward the front of the furnace, which will make it easier to melt and work down.

The working down of the charge is started about 2 hours after the blast is on. This is done by the use of green poles and is considered an important part of the melting. The unmelted iron is brought into the pools of iron under the cover of the slag, thereby cutting down the oxidation losses and decreasing the melting time.

Most of the iron is handled in bull ladles running on an overhead rail and having a capacity of about 350 pounds of iron. This method of handling calls for hotter iron at the spout than if the metal were carried in hand ladles from the furnace. It takes about 20 minutes longer to sufficiently superheat iron for successful handling in the bull ladles. The temperature of the iron measured with an optical pyrometer at the spout is about 2600 to 2650 degrees Fahr.

After a few rounds of the bull ladles it is possible to cut the fire down, and usually, before the heat is half poured, the blast fan can be turned off and the oil cut down. Sufficient fire must be kept, so that the iron will not turn cold the last of the heat.

The size of heat varies from 16 to 38 tons and it has been found that different firing must be used on small and large heats. Usually the compressed air at the start is turned on about one-third and gradually increased to capacity in one hour. The bottom blast is started about one-half, although, this depends entirely on the size of the heat and outside conditions. The iron starts to drip in front during the first 30 minutes, and the bottom blast is so regulated as to move the hot zone gradually toward the back. The amount of fire over the rear bridge wall of the flame in the stack as seen through a hole over the rear bungs is an indication of proper operation.

Not much top blast is used for melting and often practically an entire charge

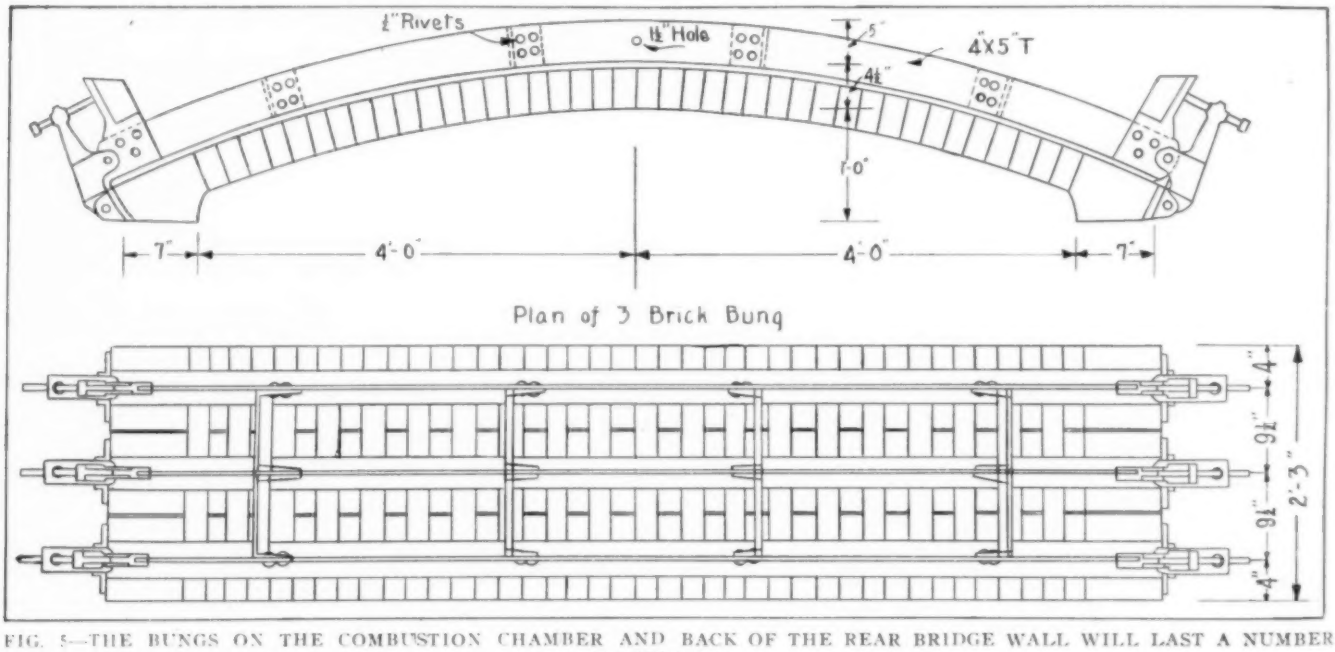


FIG. 5—THE BUNGS ON THE COMBUSTION CHAMBER AND BACK OF THE REAR BRIDGE WALL WILL LAST A NUMBER OF MONTHS

is melted before the top blast is used. This depends on how the charge is melted. The top blast is regulated to deflect the burning gases on the charge, and care must be taken not to use too much, which would oxidize the metal abnormally.

It would be better to heat the entire charge to a red heat before the iron starts to drip, but this would increase the melting time, and since the heats are ususally large, the iron must be melted as soon as possible, regardless of the amount of oxidation. The average time to get the morning heats ready is 19 minutes per ton and afternoon heats 15 minutes per ton, although getting ready in from 12.5 to 14 minutes is not unusual.

Eight heats are poured daily, four in the morning, two each at 6:30 and 8:00 o'clock. The afternoon heats are poured as soon as the iron is hot. The molders do not pour their own molds, this being handled by a separate pouring gang which is kept busy during the day shaking out castings, cutting sand, and cleaning up the foundry.

Describes Furnace Crew

The labor on the furnaces is low in comparison with the amount of iron melted. Two night men, each firing two furnaces, put in 12 hours. These men get the furnaces started and at 4:00 a.m. the firemen and skimmers on the first two furnaces start work. This heat is tapped at 6:30 a.m. On the next two furnaces, the firemen and skimmers start at 5:30 a.m. and this is tapped at 8:00 a.m. One slagman is used to pull away the slag from the skim door on each pair of furnaces. A furnace foreman and assistant, each looking after two furnaces, make up the entire furnace crew. The furnace men are paid on the amount of oil used per ton of iron melted. This gives the men an incentive to watch the fire closely and thereby cut the oil consumption. The oil bonus is figured on the gallons per ton of iron melted during the pay period.

The furnace repair is in charge of the furnace foreman. The bottom of the furnace is taken up once a week and replaced with fresh additions of washed silica sand. The 9-inch inner side wall extending the entire length of the furnace is repaired weekly. The combustion chamber usually stands up one month without any repair. The rear bridge wall is repaired or rebuilt whenever necessary, usually every week or two.

In the construction of the bungs 147 bricks 9 x 4 x 2 inches are used. All bungs are 27 inches wide except the wind bung which is 18 inches. Fig. 5 shows the bung construction used. The average life of the charging and wind bungs is about seven heats, whereas, the bungs on the combustion chamber and back of the rear bridge wall will last a number of months.

All castings are used for automobile production and call for the highest grade of malleable, both as to appearance and strength. Uniformity of the product is desired and is accomplished through the use of a well equipped laboratory. Preliminary analyses are run on the heats, so that few heats are tapped without knowing within fairly close limits the analysis of the iron. The preliminary analysis is run for carbon, silicon, and manganese. The sample is taken as soon as all of the iron is melted, the first skimming completed and the iron thoroughly mixed. Often it is found desirable to take a preliminary sample from the front and rear door. The length of the furnace, the manner in which the charge is placed in the furnace, and the difficulty experienced in the melting down, determine the advisability of taking two preliminary samples. The analysis should be finished about 15 minutes before the iron is ready to tap. Petroleum coke, 50 per cent ferrosilicon and 80 per cent ferromanganese are used to bring about the desired composition of the iron. These additions should be made at least 15 minutes before the iron is tapped to allow the composition of the metal to become uniform throughout the whole bath. The composition aimed for is as follows:

	Per cent
Carbon	2.40 to 2.55
Silicon	0.85 to 1.00
Manganese	0.22 to 0.30
Phosphorus	Less than 0.22
Sulphur	Less than 0.07

The charge going into the furnace depends entirely on the per cent of hard iron scrap and sprue on hand. The maximum and minimum are as follows:

	Per cent
Pig iron	40 to 50
Hard iron scrap and sprue	40 to 48
Malleable scrap	Up to 13
Steel	Up to 4

The analysis of the charge going in is as follows:

	Per cent
Carbon	3.08 to 3.25
Silicon	1.30 to 1.80
Manganese	Around 0.60
Sulphur	Less than 0.06
Phosphorus	Less than 0.22

The oxidation of carbon is high when using oil as a fuel. The largest per cent of this element is burned out during the melting. However, if the iron is held any length of time when hot, the carbon burns out rapidly. The first heat in a cold furnace usually burns out more carbon, and allowance is made for this in the charge. The addition of petroleum coke takes care of the necessary increase in carbon. This must be added to a perfectly clean bath, free from all slag, and shortly before tapping, otherwise, the desired increase in carbon is not obtained. It has been found that after the addition of petroleum coke, the iron must be mixed thoroughly as the carbon taken up from the coke seems to segregate and give a large variation in carbon in the same heat. The per cent of carbon increase obtained from the addition of coke sometimes varies considerably and shows the importance of adding the necessary amount under the proper conditions.

The oxidation of silicon almost is complete when the iron is melted. The base at which the silicon goes into the charge varies a great deal. Morning heats burn out from 5 to 15 points more silicon than the afternoon heats, which vary on the different furnaces due to a colder furnace, which increases the melting time. When large heats are melted, which almost completely fill the furnace the silicon loss is excessive. This makes it necessary to vary the silicon base according to the size of the heats. An abnormal loss of silicon can be detected by the nature of the slag, as a high silicon loss gives a very fluid slag.

Use Ferromanganese

Ferromanganese is added to every heat about 15 minutes before tapping. This element, like carbon and silicon, is oxidized almost completely when the metal is melted. The usual pig iron obtained does not run high enough in manganese to eliminate the addition of ferromanganese to every heat.

Little attention is given to sulphur and phosphorus, since these elements do not change much from that found in the pig iron. However, an occasional analysis is made to check the analysis submitted by the blast furnace.

In conclusion, the writers do not wish to convey the idea that using oil as a fuel in the melting process for making malleable iron is without its troubles. This article has been written merely to show what can be accomplished regularly on a production basis. There is no question that many of the present malleable producers can change from their present hand firing with coal to fuel oil, with satisfactory results, and at a cost which would warrant such a change. This change would eliminate a great deal of the human element so essential in the operation of hand firing, give a better control of the time element, and other desirable features.

C. D. Price, who has been connected with the Industrial Works, Bay City, Mich., for a number of years, recently as traveling service engineer, has been appointed district sales manager of the St. Louis district with headquarters in the Railway Exchange building, St. Louis.

Making Good Castings Better

How the Foundryman and Engineer Should Co-operate for Mutual Benefit—Changes in Design Sometimes Necessary—What Is Required To Insure Sound, Strong, Clean Castings

BY E. V. RONCERAY

DIFFICULTIES and misunderstanding which arise between engineers and foundrymen principally are due to mutual unfamiliarity with each others' problems and to a great extent would be eliminated if each possessed at least a working knowledge of the other's methods and practices. Progress in the proper direction has been noted in recent years by the introduction into the foundries of men with engineering training and by the growing practice of insisting on designing engineers securing practical shop experience.

The engineer specifies sound, strong castings, but at the same time frequently furnishes a design that defeats its own object. The foundryman may meet the requiremnts so far as outward appearance is concerned, but with a defective design, internal strains may be present which in some parts of the structure nearly are at the breaking point. Unfortunately up to the present no practical method has been discovered for the detection of internal casting strains. Possibly a method may be discovered in the future, or an instrument may be developed for this purpose. However, nothing yet is in view along this line.

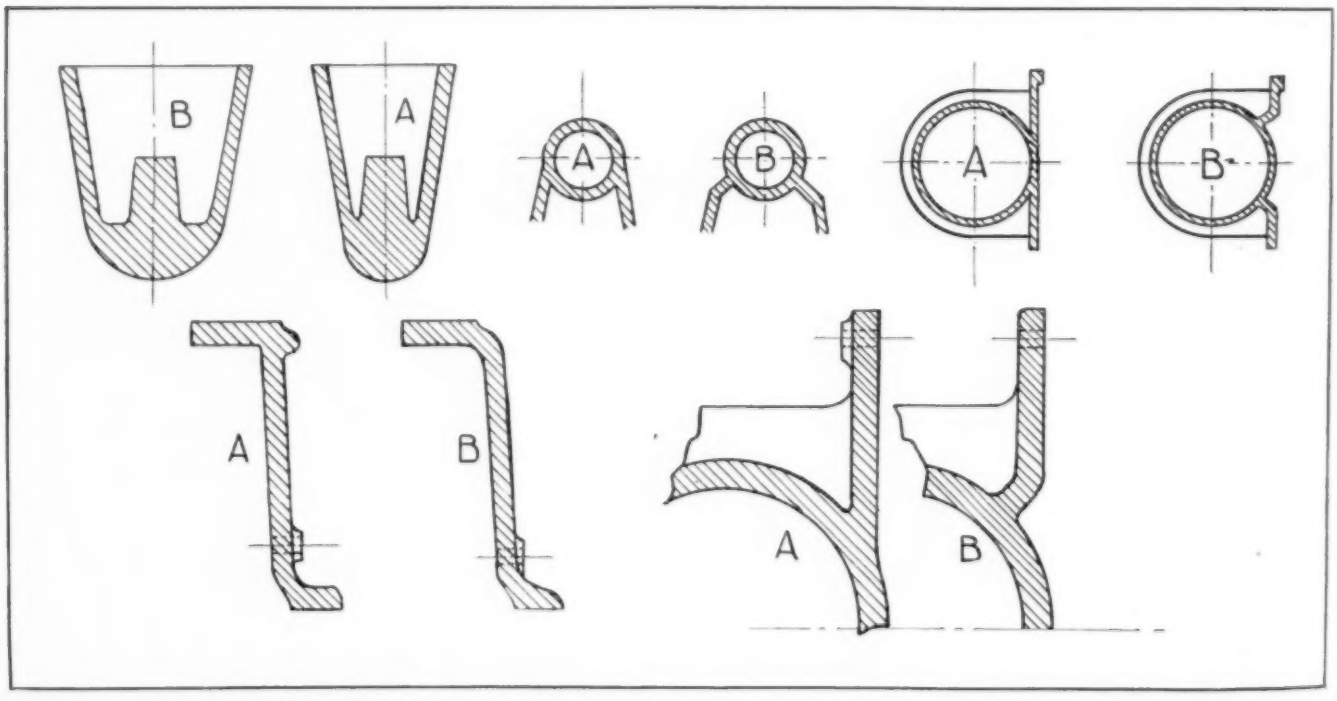
Several methods are available for reducing internal strains to a minimum. Some of these which may be classified as preventive measures quite properly come within the province of the engineer or designer. Others which are remedial measures are applied by the foundryman. The engineer should design castings with, as nearly as possible, uniform metal thickness and should avoid any tendency toward abrupt changes. Under certain conditions where the finished part presents different thicknesses, the casting might be produced with a uniform thickness and afterward machined to the necessary contour if the cost is not prohibitive.

Relieve Internal Strains

Various expedients are practiced in the foundry to relieve internal strains and to produce strong castings. Gates and runners are placed close to the thin sections in an attempt to equalize the cooling speed all over the casting. Chills and denseners are placed in various parts of the mold for the same purpose. Castings occasionally are heat treated after they are poured which means that they are cooled slowly from a given temperature after the manner practiced in the production of chilled car wheels. Cores entirely surrounded with metal are made in such a manner that they collapse readily and offer no marked resistance to the contraction of the metal. Certain binders are more suitable than others for this purpose. Usually it is considered advisable to prepare these cores in the form of a shell. The outside is baked, but the inside is filled with green sand after the core is placed in the mold. In other instances entire green sand cores are employed.

Many castings are stripped on the outside immediately after they are poured while the center remains covered. With other castings this method is reversed and the center is stripped while the outside remains covered. Pulleys and other castings of a like character are grouped in the second class. After the casting has set, the hub is stripped and the center core is removed so that air may circulate through the opening and assist in cooling the hub. All the

Abstracted from a paper presented at Birmingham at a meeting of the Institute of British Foundrymen. The author, E. V. Ronceray, is a member of the firm Ph. Bonvillian & E. Ronceray, Choisy-le-Roy, near Paris, France.



IN EACH OF THE EXAMPLES SHOWN THE DESIGN INDICATED AT *B* WILL YIELD A MORE SATISFACTORY CASTING THAN THAT MARKED *A* ON ACCOUNT OF THE MORE NEARLY UNIFORM METAL THICKNESS

foregoing processes are practiced to a greater or less extent, but each one adds to the cost of producing the casting and it should be the province of the engineer to so design a casting that all the costly after manipulation is not necessary.

In advocating pouring iron castings without shrink heads no pretense is made that improvement is secured merely as a result of abolishing risers. The point to be remembered in a discussion on this subject is that feeding heads almost always are used to correct an anticipated defect in the casting. The metal in the riser is provided to compensate for the draw in the casting. This is one of the instances where the real trouble is not recognized and where the foundryman is provoked into using a wrong method to meet it.

Joseph Leonard, Farciennes, Belgium, past president of the Belgian foundrymen's association has advanced an interesting theory on the feeding head problem. He explains that frequently large quantities of gas develop and collect at various points of the mold where the sand either of the core or the mold is not sufficiently permeable and where it is heated almost to the temperature of the molten metal. The gas unable to escape through the sand forces its way through the liquid metal and produces various defects referred to later as black spots, blow holes, porosity, etc. In one instance black spots in motor cycle cylinders were prevented by the simple expedient of venting the cores more liberally than usual. Many defects of this character disappear when special attention is paid to ramming and venting the sand at congested points.

Castings of angular formation and varying thickness with unusual projections require to be handled in a special manner. If handled in ordinary routine manner they either will be scrapped immediately after they are shaken out or later when defective areas are exposed in the machining and assembling operations. Typical castings of this character are shown in the accompanying illustration at A. The same castings redesigned to eliminate shrinkage and contraction strains are shown at B. Congested points in design should be avoided. For example, in an automobile piston, instead of providing a set of complete ribs meeting at different angles, they should be cut off individually and the corners rounded. Thin cores should be avoided wherever possible. They are extremely difficult to vent properly and easily fuse to the walls of the casting. In many instances it is preferable to take care of small holes and narrow solts through a machining operation.

To secure clean castings it is essential that clean iron is poured from the ladle. Usually the metal is not quite clean and attempts to clean it before it is poured are only indifferently successful. Slag or foreign matter of any kind introduced with the iron will result in a porous area at its final resting place in the casting and therefore no effort should be spared in trying to keep it out. It is equally essential to prevent the introduction of air with the metal. According to an extended series of observations by Edgar A. Custer while engaged in the development of permanent molds, when free air enters the mold in company with high sulphur iron a reaction takes place and SO_2 is produced. This gas caused blowholes both in chill and sand castings, especially if the temperature of the iron is below 2200 degrees Fahr.

Value of Strainers

Pouring speed should be regulated according to varying circumstances. The plug or stopper method is used quite extensively for this purpose, particularly in Great Britain. Tinned strainers are employed on repetition work where the proper style and thickness of strainer may be determined by experiment. Strainers and strainer cores are widely used in American foundries and apparently give satisfactory service. The cores are simple disks about ½ inch thick with several ¼-inch holes through them. They are placed over the entrance to the runners. Each core is covered with strong paper which prevents any particles of dust or slag entering with the first iron. The paper burns in a fraction of a second, but the delay is sufficient to allow the metal to precede any foreign material. The filter core also prevents air from entering with the iron.

Too much effort cannot be expended in securing a clean runner. This important feature rarely is considered properly. Practically all attention is devoted to producing a clean mold. It is highly important that gates and runners should be thoroughly clean and special attention should be paid to measures that prevent scabbing and washing. Wherever possible machined surfaces should be cast on the lower side of the mold. An allowance of ⅛-inch extra metal should be provided on a machined surface where it appears in the cope. Particles of sand and blacking always are washed up by the iron and little drops of slag collect on the top forming blowholes and deposits of dirt.

Foundrymen in every country seem to have different ideas on the most satisfactory method for estimating the strength of cast iron. In France test pieces are taken from various vital points of the casting. This method only is varied when the cost is prohibitive. At the Paris international foundrymen's cogress Dr. Moldenke admitted that the French method is ideal from a scientific standpoint, but is rather expensive and therefore is not practical. This view is subject to challenge.

The Fremont test consists of shearing a test piece less than ¼ inch in diameter. A small hollow drill is employed to remove the test piece from the casting. The piece then is tested on a small inexpensive machine. In many cases the hole left by the drill may be utilized as one of the bolt holes in the finished casting. In other cases it may be tapped and plugged. In a great many instances the hole does not affect the casting in any manner and requires no further attention. Occasionally a casting may have to be sacrificed. Four or five tests may be made from a test piece 1 inch long.

The founder should spare no effort to produce sound, clean, smooth castings from either soft or hard iron to meet specifications. The engineer should consult the foundryman on the proper molding method for each job and then design the parts according to the foundryman's recommendations. This kind of collaboration will insure progress in the industry.

To Sell Foundry

At trustees' sale, property, plant and equipment of the Peerless Foundry Co., Latrobe, Pa., will be disposed of on June 24 by the Commonwealth Trust Co., 312 Fourth avenue, Pittsburgh, trustee. John F. Post & Sons, Pittsburgh, will act as auctioneers. The property consists of more than five acres of land, a foundry plant including several buildings, machinery and equipment. Supplies and manufactured as well as partially manufactured material located on the property also will be sold free of liens and encumbrances.

Change Association Name

At a meeting held recently it was decided to change the name of the Liege Foundrymen's association, Belgium, to Association Technique de Fonderie de Belgique, in other words, Belgian Foundrymen's association. The Liege association for many years has been the only one in Belgium and is a national foundrymen's association. Therefore, the change in name merely confirms the existing situation. Gustave Masson, Liege, is president.

H. C. Bement has joined the engineering force in the electric furnace department of Wm. Swindell & Bros., Pittsburgh.

Pioneer Auto Foundryman Retires

Early Training Gained in Eastern Shops Under Veterans Fitted Joseph J. Wilson for Later Cylinder Casting Work

JOSEPH J. WILSON who recently retired from active management of the foundry of Hiram Walker & Sons Metal Products, Ltd., Walkerville, Ont., Canada, has just completed 54 years of foundry work. His first job was with the Akron Foundry Co., Akron, N. Y., a small plant making agricultural implement castings and stove plate, in the days when these important foundry products were made in widely distributed plants and for local demand. Mr. Wilson started in this work in 1870 when he was only 14 years old and spent 4 years, learning the trade and going to school in the winter term. After a time, he decided to seek employment where he would gain a wider experience, and accordingly started to work for Darly & Peek, East Aurora, N. Y. After a year in this shop he returned to Akron and remained until the growing activity of the larger implement and stove plants cut down the demand for the small shop's output. At this time, after seeking a job as molder in various centers, Mr. Wilson was forced to work as a machinist's helper for the Fallbrook Coal Co., Corning, N. Y., but finally was transferred to the B. W. Payne & Son foundry where he could again apply his experience as a molder. When a slack period ensued a few months later he drifted to Gardner & Sons, Lockport, N. Y. and later to the Fishell foundry, Oakfield, N. Y., returning for a short time to the Gardner plant.

In August, 1882, Mr. Wilson removed to Ansonia, Conn. where he became a molder for the Clemens foundry, which after a year and a half was sold to the Farrel Foundry & Machine Co. Here he worked as a molder for six or seven years, finally being put in charge of the light work section as assistant foreman, a position which he held for 12 years.

June, 1902, marked the entry of Mr. Wilson into the automobile work which afterward claimed his entire attention and brought him distinction as a foundryman. At that time he accepted a position with Leland & Faulkner Mfg. Co., Detroit. This company later was taken over by the Cadillac Motor Car Co., and finally was absorbed into the General Motors Corp. W. C. Durant, president of the General Motors Corp., in 1909 requested Mr. Leland of the Cadillac company to assign Mr. Wilson to take charge of the Michigan Motor Castings Co., Flint, Mich., a foundry largely owned by the Buick Motor Co., and engaged in making castings for the latter interest. From that time until 1918, Mr. Wilson managed both the Cadillac and Buick foundries, introducing much of vital importance in cylinder casting practice and training a number of men who at present occupy important positions in the automobile cylinder casting industry.

In 1918, Mr. Durant offered Mr. Wilson complete charge of constructing and placing in operation a large foundry planned for the General Motors Corp. at Saginaw, Mich., later known as the Saginaw Products Co., Central Foundry Division of the General Motors Corp. This large structure, built to employ 900 men and to produce 200 tons per day of finished castings was cited as the highest example of automotive foundry construction at its completion in 1919. Mr. Wilson was invited to present a paper on the plant at New York meeting of the National Founders' association in 1920. In this he analyzed the features underlying the proper choice of molding, handling, and finishing equipment, applying the principles learned through his previous wide experience in the shops noted. At the completion of his work with this foundry, in 1921, Mr. Wilson accepted a position with Hiram Walker & Sons Metal Products, Ltd., Walkerville, engaging to put the foundry in smooth running operation with the understanding that he might retire when this was accomplished. He availed himself of this privilege on April 1, withdrawing from active participation in the management, but being retained in a consulting capacity. Mr. Wilson expects to spend the next year or two in travel in America and abroad, with places which an exceedingly active life has prevented his visiting previously.

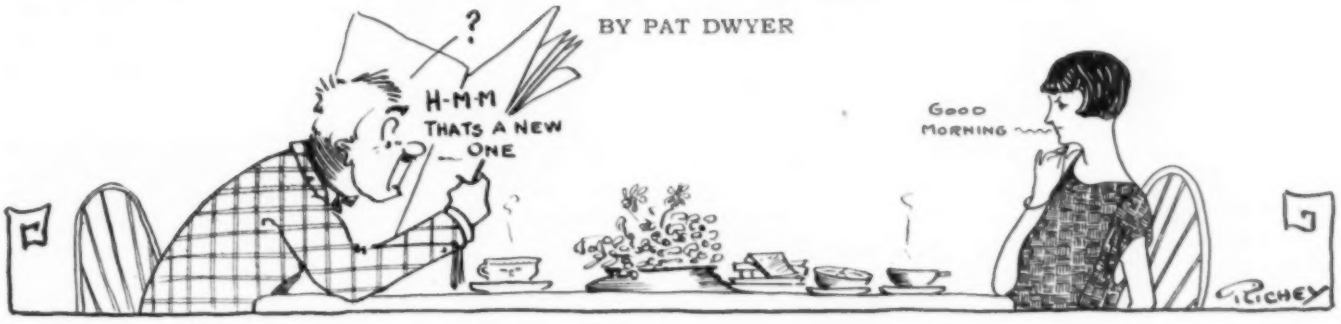
Occupies New Building

The Detroit Testing Laboratory has moved into its new building at 554 Bagley avenue, Detroit. The new home, a three-story, fireproof structure, is occupied exclusively by the different departments of the laboratory. The particular needs of the different departments, which include organic and inorganic chemical analyses, metallurgy, metallography, bacteriology, physical and electrical testing, were considered carefully in designing the building. In addition, provision has been made for carrying on special research and investigational work in various industrial lines. The laboratory was established in 1903.

The office of the Franklin Core Rod & Gagger Co., Franklin, Pa., has been moved to the News-Herald building.

Bill Airs Views on Sashweight Castings--VII

BY PAT DWYER



HAVE you ever noticed the manner in which an odd or peculiar word keeps bobbing up after you have discovered it yourself or some person has directed your attention to it? You have lived a long and—let us charitably assume—an exemplary life. You have read the daily paper either in the morning or at night depending on circumstances. If you are thoroughly modernized, which means that your bump of curiosity is developed to a point where you simply cannot wait until morning for news of the night before, you have read both morning and evening newspapers. In some people the practice is merely a habit while in others it seems to develop into a regular mania. I have known men whose whole disposition for the day hinged on whether or not they had seen the morning paper. Give one of these men a paper in the morning and he behaves all day like a normal human being. If through some unavoidable accident he is deprived of his morning pleasure he is about as friendly and companionable as a prowling wildcat. This despite the fact that his mind is like a sieve and retains nothing of what he reads.

However, that is beside the point. What I had in mind is the average reader, who reads his paper in the same routine manner that he eats his breakfast cereal, through habit and without any marked enthusiasm. The omission of either one would not particularly affect his equanimity. In glancing idly through the columns some fine morning his eye falls on a word like autocthonous, a word he is quite positive he never has seen before. According to accepted mathematical formulas or principles, it is apparent that if a man arrives at the age of 40 before he sees a certain word, it is reasonably safe to assume that he will not live long enough to see it again. Experience does not bear out mathematics in this respect. So sure as you spot a peculiar word one morning you will find it staring at you impudently from some unexpected location at least three or four times before the week is over.

The same uncanny feature seems to characterize certain items of more or less useful information. The only difference seems to be that these items persist over a longer period of time. A few years ago a prominent motor car manufacturer erected a blast furnace with a view to supplementing his cupola output with a certain amount of direct metal.

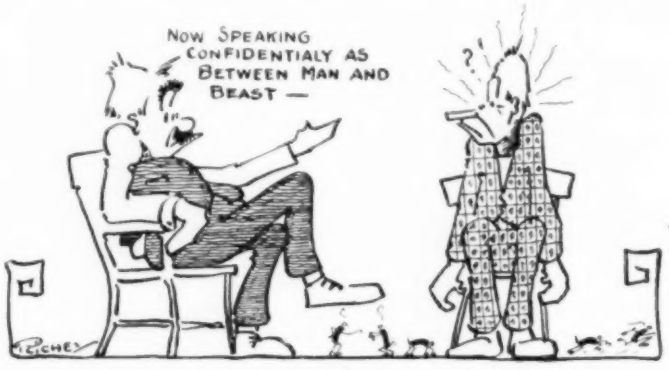
The idea was not strictly original. In the early days of iron making, castings were poured from direct metal. In our own day, blast furnace plants utilize part of their output in the manufacture of certain castings that play an important part in their operation, such as runners, spouts and plates. At least one prominent cast-iron pipe shop draws on a nearby blast furnace for a certain part of its output which is mixed with the cupola product and poured into the molds. The output of many blast furnaces running on bessemer iron is diverted in whole or in part to the manufacture of ingot molds, ingot stools, hearths and jackets.

All these well known facts calmly were ignored when the motor car plant built its blast furnace. Newspapers all over the country with the smug complacency, all pervading omniscience and utter disregard for accuracy, when accuracy conflicts with socalled news interest, which characterize the modern newspaper, carried long stories supplemented with editorial comment on this wonderful achievement and epoch making development in the manufacture of castings. Typical head lines informed a breathless public that in future castings would be made direct from the ore. We were informed confidentially that this marked the greatest forward step ever undertaken in the industry. The manufacturer's well known reputation for utter disregard of convention and precedent lent an air of credence to the story and in general it was accepted by the public at its full face value. The story was not confined to the newspapers. Several technical magazines that presumably should have known better carried it in its entirety while others commented on it editorially in a eulogistic manner. Practically the only accurate account of the process, an account based on personal investigation, was published in the Oct. 1, 1921 issue of THE FOUNDRY.

Despite the fact that at no time did the proportion of direct metal exceed 40 per cent and usually only amounted to 30 per cent of the total amount of iron poured into the castings and despite the fact that afterward the use of direct metal was discontinued altogether for some of the castings, the direct metal story still persists and bobs up occasionally here and there. The last time I saw it was the other day in a book devoted to scientific management. The author devotes one chapter to an enumeration of the many time, labor and material wasting methods in vogue in the industrial field. He cites many illuminating and legitimate examples, but I am afraid he rather weakens his case when he drags in this direct metal fiction by the tail. He holds up his hands in horror at the dreadful waste involved in melting the iron first in a blast furnace, allowing it to cool in the shape of pigs and then remelting it in a cupola. According to

SO DIFFICULT TO CONVINCE A DOUBTING THOMAS

his idea of efficiency, this intermediate melting is wasteful, extravagant and unnecessary. In justice it must be admitted that he does not claim all castings may be poured from direct metal; but he boldly claims that all *heavy* castings should be poured direct from the blast furnace. With a brief and authoritative wave of the hand he dismisses all the mechanical and metallurgical problems involved in a proposition of that character and calmly lays it down with dogmatic finality. In the course of a long and varied career Bill has had some experience with blast furnaces and the use of direct metal and naturally while the subject was fresh in my mind I sought an expression of opinion. He chose to treat the subject in rather a flippant manner.



SOME PEOPLE'S REMARKS ARE SO PERSONAL

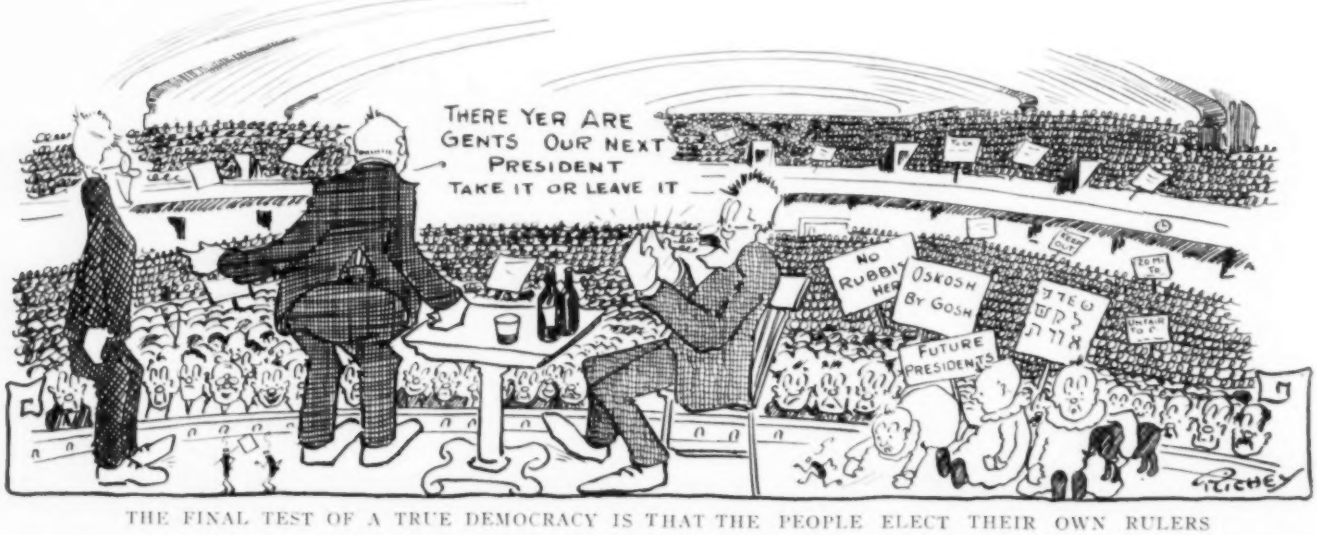
"Your reference to a blast furnace," he said, "reminds me of a little sketch put on by a friend of mine a few years ago with a rising young get-rich-quick artist as the leading character. This foundry superintendent frequently had been pestered by a lad from the general office who in some way was related to the president and therefore was free to come and go when he pleased. In his cheerful ignorance of foundry practice he lost no opportunity for making suggestions for the good of the service. For example, he worried over the invoices for mold and core wash.

" 'I should think,' said he, 'that if you taught your men habits of personal hygiene and instructed them to keep their hands clean, if you afterward dried the molds and cores in a clean, sanitary oven, it would not be necessary to wash them after they were dried!'

"The superintendent listened to the suggestion with every appearance of the liveliest attention and admitted that the idea merited the closest consideration. The only reason he had for not putting the idea into instant execution was the shop was rushed with war orders, men were scarce, molders were queer birds anyway, and he was afraid if he asked them to wash their hands each time they were soiled, the men would resent his action as an unjustifiable interference with their inalienable rights and he probably would find himself with a strike on his hands. As an after thought he added that he was thinking of substituting Lux or Old Dutch Cleanser for the more expensive wash and he expected to effect quite a saving in that manner.

"At various times the young man expressed his deep disapproval of the criminally wasteful practice of destroying a mold after it was poured. He pointed out, quite logically, that iron shrinks ⅛ inch to the foot and as a result the casting invariably is smaller than the pattern. He could not see for the life of him, how, if the molders observed even ordinary care they could not remove the casting in such a manner that the mold could be used again. The superintendent professed to be greatly astonished at this momentous discovery. He said it just went to show how an intelligent outsider, with a fresh and unbiased mind invariably could place his finger on the weak point in any process. Molders, like other craftsmen are creatures of habit. They always had made molds in a certain manner and the idea of using a mold more than once probably never had occurred to any of them.

"The great inspiration came to our hero one day after he had seen a crane equipped with a magnet unloading pig iron in the yard. He rushed into the foundry with his eyes popping. 'Say Jim,' said he—did I tell you the foundryman's name was Jim?—'Say Jim,' says this brave lad, 'Is there not some way we can procure iron direct from a blast furnace and avoid all this expense of shipping and remelting?' Well you know how it is. Opportunity knocks but once. Jim grasped him enthusiastically by the hand and assured him that in all the time he had been a foundryman he never had heard such a brilliant suggestion. He proposed to the young man that they immediately organize a stock company to build a blast furnace capable of supplying all the foundries in the city. In consideration of a thousand shares of stock, no par value, he agreed to work out all the mechanical details connected with the distributing equipment and in consideration of the young man's well known business ability he suggested that his job would be to promote the company and sell the stock. Just to convince the young lad of the feasibility of the plan, Jim sketched a tentative layout on the core oven door showing the blast furnace discharging molten metal into one end of a long, brick lined pipe and with a branch pipe leading to every foundry in the vicinity. He showed how the flow of metal through each pipe



THE FINAL TEST OF A TRUE DEMOCRACY IS THAT THE PEOPLE ELECT THEIR OWN RULERS

could be controlled by a suitable gate valve. He admitted that the sketch was rather crude, but he was sure the young man could grasp the salient features and he expected to work it out more in detail later. In fact he claimed that eventually he expected to install a meter in each pipe to measure the volume of iron delivered to each foundry and in that manner the book keeping expense would be reduced to a minimum.

"Our hero went prancing out through the door like a colt with his tail over the dashboard and with the unbounded confidence of youth and ignorance—a combination hard to beat—in all seriousness laid his brilliant scheme before the president and executive staff. These men had such implicit faith in Jim's foundry ability, a faith based on several startling innovations he had introduced from time to time during his tenure of office, that they summoned him to attend the conference. At first he thought they were joking, but when they started haggling over his demand for 1000 shares of stock as his share, he threw the bombshell that blew up the works. The young man's resignation, as they say in our best circles, was accepted reluctantly and the last Jim heard of him was when he was pinched in New York for absent mindedly placing another man's name on a check. However," said Bill in conclusion, "that's neither here not there, but talking of ways and means for doing things reminds me of another phase of this here sashweight business.

Patented Methods

"Before leaving the subject of sashweight manufacture it may not be out of place to say a few words about methods that have been patented at one time or another. None of them so far as we know ever has been practiced on an extensive commercial basis, but that does not reflect on intrinsic merit and may be due to any one or any combination of various causes. For example in one case the method was discontinued when the company operating a general manufacturing establishment, went out of business. In another the inventor was not in a position and did not care to push it personally. He wanted to dispose of his rights on a royalty basis and perhaps failed to give the merits of his proposition sufficient publicity. In one or two cases the patent covers the entire process, in the others the patent only applies to one feature. Taking them one after the other, but without observing any regular sequence either alphabetically or chronologically a few words may be appropriate on each method. As I said, the methods are patented and therefore any attempt to duplicate them, properly may be regarded as an infringement, but like any other patented process, a description is legitimate and usually is of interest to others engaged in a similar or allied field of industry.

"Inventors have tackled the problem from various angles. Some have viewed it solely from a production standpoint and have directed their efforts toward developing a method for turning out the castings economically in large numbers. Others have considered only the distribution end of the problem and sought to lighten the burden of the dealer by limiting the number of sizes, or by providing a sectional casting that might be built up to any desired weight. Proponents of this idea claim that the slight amount of time and labor involved in assembling sectional weights is in no way comparable to the expense and annoyance incident to carrying an immense stock or various standard sizes. They point to the floor space that may be conserved, the shipping problem that is simplified and the reduction in the amount of invested capital represented by the smaller tonnage of castings required to be kept on hand.

"Both of the foregoing features were taken into consideration by the inventor of a permanent mold for sashweights who designed a rectangular weight provided with a twisted hook at each end. When in use the upper hook was attached to the sash cord and the lower hook served as a support from which to suspend an additional weight. The twist in the hooks automatically locked them in position and prevented them from coming apart in the up and down movement of the window sash. Within practical limits any number of weights might be suspended in a row under the first. The resulting combinations or ultimate weights were limited to multiples of the first unit. The original mold was designed to produce several unit sizes and therefore practically any combination could be made up in large numbers from a comparatively small number of individual sizes.

"Each mold was designed to produce ten castings each time it was poured. One half of the mold was stationary and the other half was movable. The mold was set up on edge with the parting line in a vertical instead of the usual horizontal position. In passing it may be noted that this feature characterizes practically all permanent molds and distinguishes them from the ordinary type of mold where one half of the mold known as the cope forms a lid or cover for the other half. It is lifted off for the removal of the pattern and afterward for the removal of the casting. The lifting equipment is eliminated where permanent molds are employed. One half of the mold is drawn back horizontally from the other half to facilitate the removal of the casting. Afterward it is returned to place to receive the succeeding charge of metal. Usually the movable half is mounted on slides. Sometimes it is mounted on small wheels, balls or rollers and occasionally it is attached by hinges to the stationary half of the mold. In any case it is provided with suitable handling and locking devices. Usually the casting or castings may be removed with a pair of tongs, but in some instances it has been found advisable to provide the mold with ejector pins which automatically come into action and force the casting or castings out of the mold immediately when it is opened. In this respect it resembles the molds employed in die casting some of the nonferrous metals.

"A prominent eastern firm makes sashweight castings according to a method I described some time ago. They are molded horizontally in tiers in a flask provided with a number of small openings in one end through which the patterns are extracted from the sand. The patented feature of the process in this particular instance is the method of making the core that serves for a plug in the open end of the mold. A special corebox is provided in which several cores are made at one time. In addition to serving as a plug, the core forms the eye in the end of the casting and also imprints a figure to designate the weight in pounds.

Sectional Weights

"In a method patented by an inventor some time ago, sectional sash weights patterns designed to weigh ½ pound each are mounted to the number of 20 or more on an ordinary matchplate for use in a snap flask on a squeezer machine. The castings may be produced in immense quantities at a minimum cost and later may be assembled to give any desired weight by passing the sashweight cord through suitable slots in opposite sides.

"A company recently has been formed in the middle west for the manufacture of a patented sashweight in which the pattern is provided with a cavity and bar on which supplementary weights may be suspended to increase the weight of the assembled unit. I think I have covered the sashweight field rather comprehensively, but if you feel inclined to ask any questions I shall be pleased to answer them to the best of my ability. Gentlemen I thank you. How's that," says Bill, "for a graceful flourish?"

"Speaking confidentially," I said, "as between man and beast I never want to hear of sashweights again. However, I should like to hear your opinions, if any, of the recent convention held in our fair city for the purpose of nominating a president for this great and glorious republic."

"Well," said Bill, "I'll tell you. There isn't much difference between nominat-

ing a president and selecting a method for making sashweights. The men in the shop are given certain equipment for making the castings and they have to use it whether they like or approve of it or not. The voters of our well known free and fair democratic commonwealth are given the choice of one or two men for president and they have to accept one whether they like him or not, an' as Mr. Dooley used to say, 'there y'are me good lad!"

Designs Portable Gas Mold Dryer

BY ALBERT ZANDER

A NOVEL apparatus for drying molds with manufactured gas, which is applicable to a great variety of work, recently has been introduced at the Kedzie Foundry Co., Chicago. The mold dryer is about 9 inches in diameter and 24 inches long. Its weight is such that it may be carried about easily and hung on flasks at convenient points. Air and gas are fed into the dryer through two flexible rubber tubes. The device is covered by a seamless steel shell, 8⅝ inches in diameter, ¼ inch thick and 18 inches long. Inside this cover is the inner steel shell. Separated by an intermediate air space from the outer shell the inner shell is lined with firebrick, perforated with holes at regular intervals.

A circular cover plate is fastened securely at the top of the inner and outer cylinder and the gas and air connections are screwed into this plate, admitting both gas and air to the inner, firebrick lined cylinder. About a third of the way down from the top another air connection is screwed into the outer shell. The gas first is turned on and ignited by a torch through the lighting hole at the bottom of the device. The air, which is supplied by a fan blast, then is admitted. This fills the outer chamber and rushes through the lighting hole at the bottom of the device. The air, which is supplied by a fan blast, then is admitted. This fills the outer chamber and rushes through the perforations in the firebrick, to the inner or center chamber.

A small amount of the air, admitted at the top, combines with the raw gas and partial combustion takes place. As the gas passes toward the bottom of the interior cylinder, more air enters through the holes in this cylinder and consequently the combustion becomes more complete. Finally, the mixture of air, gas and the products of combustion are passed into the mold. By circulating through the mold the necessary baking and drying is accomplished.

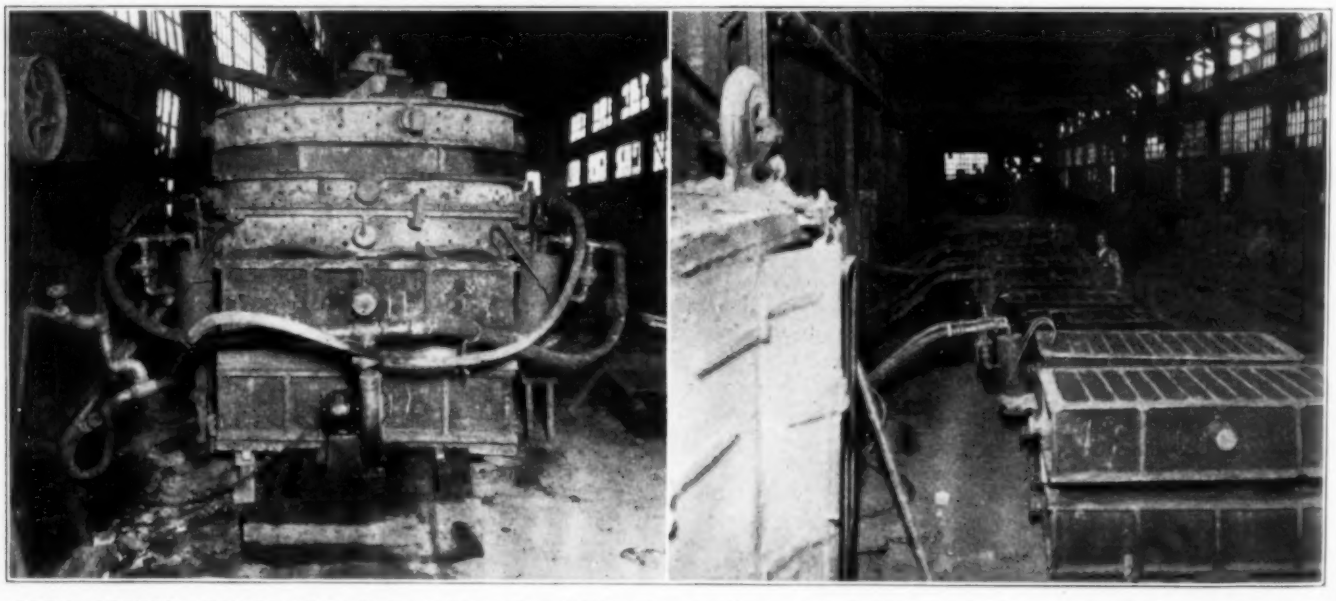
More air is delivered to the combustion chamber through the perforated firebrick than at the top. Air at a pressure equivalent to 4 inches of water column generally is used. However, compressed air may be used with the aid of an inspirator to reduce the pressure. The outer layer of air keeps the steel shells and outer surface of the refractories cool.

The gas-fired mold dryer is hung on the flask, set in operation, and in a few hours, the time depending on the size of the mold, the interior surfaces are dried. The cope then is lifted off for general inspection, and when replaced the mold is ready for pouring. Adequate gas and air piping together with flexible hose connections make it possible to move the dryer from one mold to the next as fast as the work will permit. In this way the device may be kept in constant use.

The dryer was designed by the engineering department of the Peoples Gas Light & Coke Co., Chicago. The idea was suggested by John Anderson of the Kedzie foundry.

Test Super Refractories

An investigation having for its purpose the production, by electric furnace methods, of materials of higher refractoriness than those commonly used in commercial practice is being investigated by the United States department of interior at the Seattle experiment station of the bureau of mines. The first material to be investigated is sillimanite. Two methods of preparing the material are being studied, namely, from a mixture of clay and aluminum oxide in the form of bauxite, diaspore, or alunite residue, or from clay along by removing the requisite amount of silica and iron by melting with carbon in the electric furnace. The material thus produce in the electric furnace is subjected to the methods of testing refractory materials and is fashioned into brick and other shapes and given both refractory and commercial tests.



(LEFT) DEVICE APPLIED TO LARGE MOLD FOR CASTING 1¼-TON LEAD KETTLE (RIGHT) A BATTERY OF GAS FIRED PORTABLE MOLD DRYERS MAY BE USED

Making Globe Valve Corebox

Metal Boxes Are Cast from Carefully Constructed Wood Master Patterns Where Foundry Output Is Large—In Many Cases the Pattern Is Built Up from a Number of Small Segments

BY WALTER C. EWALT

THE large quantity of valves made annually in manufacturing plants specializing in that product necessitates the use of substantial equipment in the foundry. In the production of globe valves, it is essential that metal be used for patterns and core boxes since wood quickly would wear away or warp and twist. Serious difficulty might be encountered in the latter case since the thickness of the metal would be different from that called for in the specifications. The seriousness of any such change in the thickness of the metal may be realized when it is noted that a limit of 1/64 or less tolerance often is required. For these reasons, master coreboxes are made of wood and iron, and from these castings are poured usually of cast iron. The castings are finished and then are used as coreboxes.

A sectional pattern drawing of a globe valve is shown in Fig. 3. The thickness of the metal in various sections of the casting may be noted in this illustration. All of the work about the pattern and corebox is built around the center of the seat marked *I*. All measurements must be absolutely correct to assure the right thickness of metal in the finished valve and to secure the proper fit of the two halves of the core when completed. The method of fitting the cores together before placing in the mold is shown in Fig. 4. Great care should be exercised in constructing the master patterns since, in cases where a large number of valves are to be produced, the metal working boxes will wear out, making it necessary to use the master patterns in making new metal corebox castings. The best methods in patternmaking are essential since the pattern may be held in the storage room for several years.

Single pieces of wood may be used in making patterns for the smaller size of globe valves, but for the larger sizes it is considered better practice to build up some of the parts with smaller segments. In making the parts shown in Figs. 5,6,7,8,9, and 10 the wood is fastened on the face plate and turned on the lathe. The parts shown in Figs. 5 and 7 are made in halves, the center of each part being placed exactly in the center of the face plate. The parts shown in Figs. 6,8,9, and 10 are turned from the solid piece to the shapes shown by the dotted and solid lines and later are turned to the lines shown in the sectional drawings. All of these shapes are turned to size using templets made of wood, celluloid, zinc or brass and made from the patternmaker's layout.

After the wood is turned to the shapes in Figs. 5,6,7,8,9, and 10, a block of wood is procured which has a thickness sufficient to allow a bevel the length and angle of the diaphram. A templet is made from this piece of wood so that the piece shown in Fig 5, when cut off at the angle of the diaphragm, may be worked easily to the proper angle by chalking the templet block and lying both on a straight board or plate. In the next operation a board is glued across the angle shown in Fig. 5 as is illustrated in Fig. 12. The thickness of this board as well as the thickness of the rest of the pieces may vary from ½-inch in small coreboxes to ⅜-inch in the larger sizes.

Next the center of the angle board is found as shown in the end plan, Fig. 12, lines drawn on each side of the center, the distance between the lines being the outside diameter shown in Fig. 10. The board is cut to a depth shown at *H*, Fig. 10 and as *H*, Fig. 10 is shown in Fig. 12. Then the most of the projecting ring is cut away as shown in Fig. 10, working exactly to the line of diaphragm. The piece shown in Fig. 10 then is glued on the piece shown in Fig. 13. It is essential that the recess shown in Fig. 10 be in line and that the whole of this piece be on the same plane as the center line or parting line of the box. The piece also must be in the center of the globe and at the proper distance from the clearance line at the thread chamber or at the end of the box. At least four checks should be made to assure this condition. Dividers should be used to see that the piece shown in Fig. 10 is in the center of the ball or globe. The piece illustrated in Fig. 13 is set upright on the core print end on the plate and squared with the plate. A small piece of wood of a thickness equal to the extension of the piece shown in Fig. 10 above the center line is extended across the two edges of the box. Then the square may be used to put the piece shown in Fig. 10 in the same plane as the rest of the box. At the same time the surface gage is used to seat the center of Fig. 10 as shown in Fig. 13.

The piece shown in Fig. 9 next is made. The part is constructed from one piece of wood, the radius *R* being

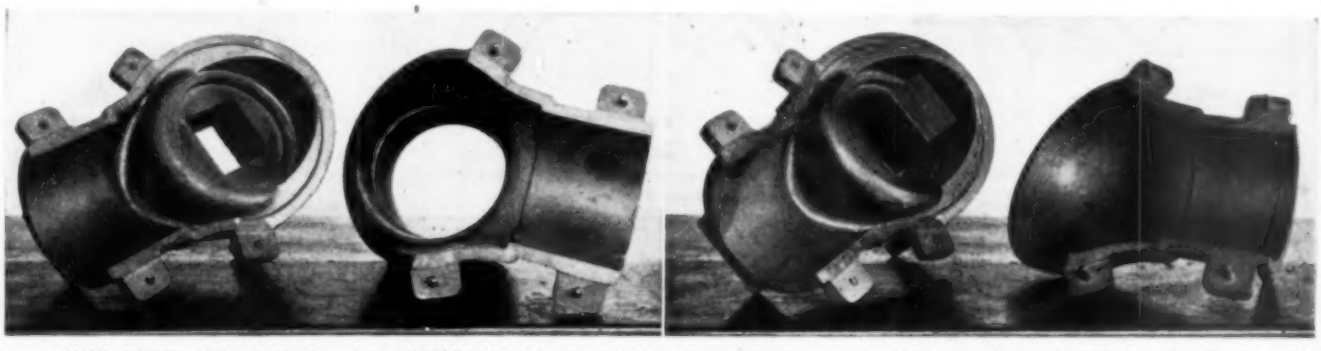


FIG. 1—THE CORE FOR MAKING THE SQUARE HOLE BETWEEN THE HALVES OF THE GLOBE VALVE IS MADE IN THE OUTLET PART OF THE COREBOX FIG. 2—OPEN VIEW OF THE INLET PART OF THE VALVE COREBOX

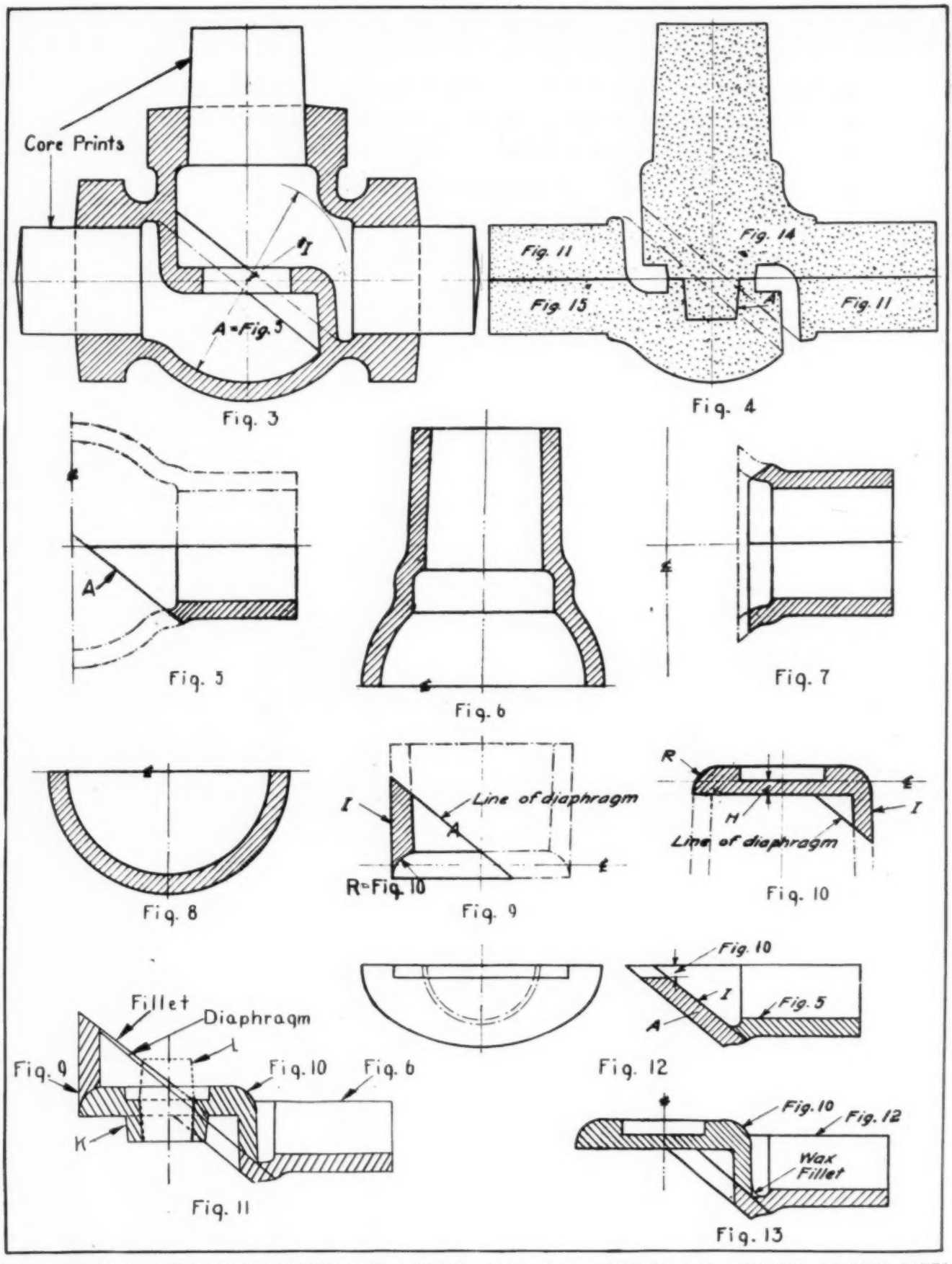


FIG. 3—SECTIONAL VIEW OF THE PATTERN FOR A GLOBE VALVE FIG. 4—THE CORE IS COMPOSED OF FOUR PARTS FIG. 5—ONE-HALF OF THIS PIECE IS USED FOR THE DIAPHRAGM FIG. 6—THE BONNET END IS MADE SOLID FIG. 7—ONE HALF OF THIS PIECE IS USED FOR THE BONNET AND ONE HALF FOR THE BOTTOM FIG. 8—PIECE USED FOR THE BOTTOM FIG. 9—PIECE MADE SOLID WITH ONLY PART MARKED *I* USED FIG. 10—PIECE MADE SOLID WITH RADIUS SAME AS IN FIGS. 9 AND 10 FIGS. 11, 12 AND 13—SHOWING ASSEMBLY OF VARIOUS PARTS

the same as *R* in Fig. 10. Only the part marked *I* is used. This part is glued to Fig. 13 as shown in Fig. 11. After the part is glued, a small frame is glued to the bottom seat. The frame usually is square with an opening cut through as shown in Fig. 13. A fillet piece is glued on to make a round corner of the casting. A small plug is made to fit in the square hole and a small piece of zinc is fastened in the center of the plug for the point of the divider. The top of the plug should be on the center line. With the divider set at the radius of the globe and the divider inclined, a line may be drawn on the fillet piece and worked accordingly. Two pieces are cast from this master pattern, one being used for the lower half on the bonnet or outlet corebox, and the other, with addition of the plug, may be used for the lower part of the bottom or inlet corebox.

The pieces shown in Figs. 6 and 7 then are made and fitted together as shown in Fig. 14. After the glue has set the piece is attached to the part shown in Fig. 11. It may be necessary to trim the piece at *A* until a close fit is secured. Some trimming may be necessary at the joint between the parts shown in Figs. 6 and 7. The same is done with the parts of the other half shown in Figs. 7 and 8. The only part that remains for the metal pattern maker is to put 1/32 or 1/16 finish for the parting lines of the boxes and apply three or four coats of shellac.

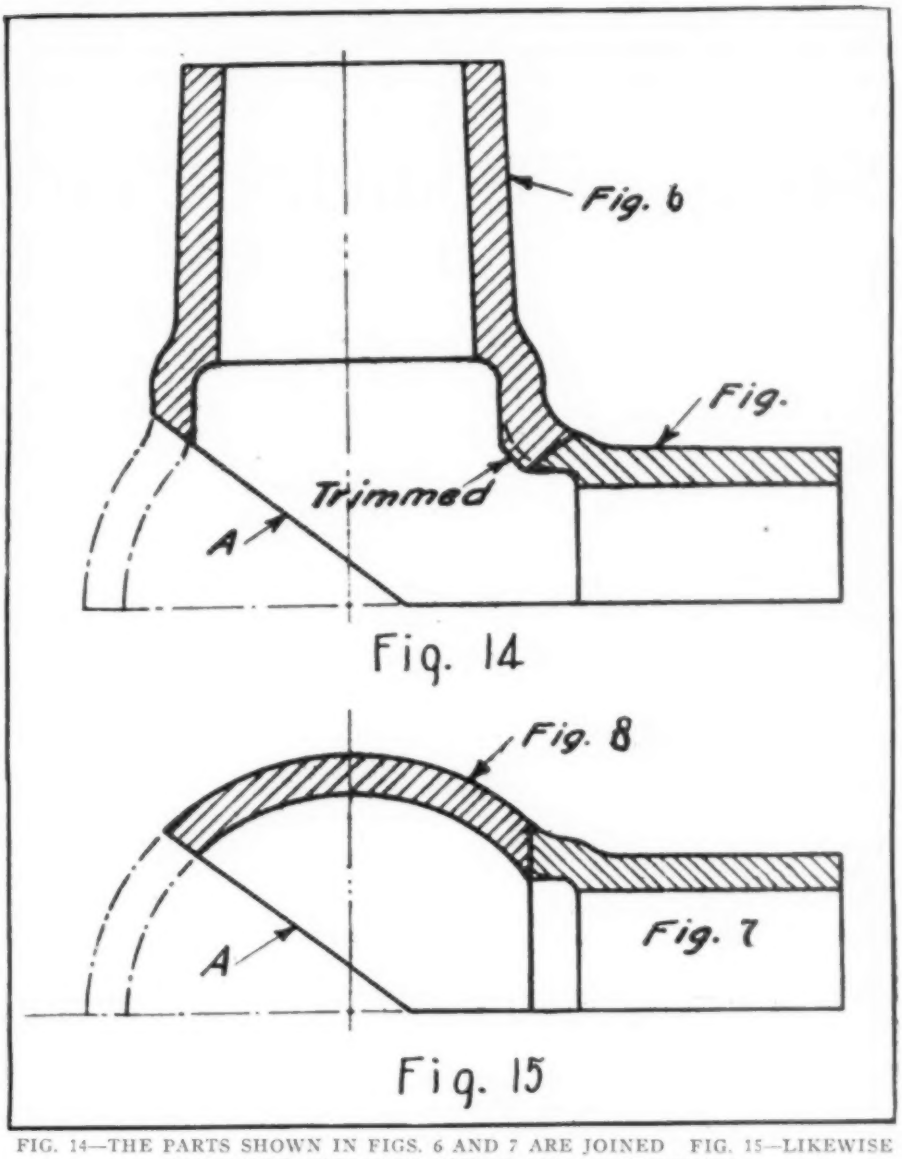


FIG. 14—THE PARTS SHOWN IN FIGS. 6 AND 7 ARE JOINED FIG. 15—LIKEWISE THE PARTS SHOWN IN FIGS. 7 AND 8 ARE JOINED

Book Review

Ferrous Metals of the British Empire, by M. S. Birkett, statistical officer, British National Federation of Iron and Steel Manufacturers; 165 pages, 7½ x 10 inches; published by Ernest Benn Limited, Bouverie Street, London, and furnished by THE FOUNDRY, Cleveland and London, for $6 in U. S. A. and £1 1s 0d in Europe.

This book constitutes a survey of the iron and steel resources of the British empire, including, in addition to Great Britain, Canada, Australia, India, etc. So far as is known it is the only modern publication in which general technical and business information regarding the British empire iron and steel industry and resources has been collected in one volume in convenient form.

The book is provided with a foreword by the Prince of Wales and general introductions by Sir Eric Geddes, president of the Federation of British Industries, and Arthur Dorman, managing director Dorman Long & Co., Middlesbrough. The volume is a part of a series of 10 on British Empire resources which is now being published.

Following a historical sketch, there are chapters on the raw materials of the British iron and steel industry and the resources for the manufacture of iron and steel in the British dominions. Following this are chapters on pig iron, wrought iron, forgings, heavy steel castings, the Sheffield industries, tin plate, sheets, wire, shipbuilding material, structural steel, hoops and strips, railroad car building material, etc., dealing in each case with the development of the industries in question in Great Britain and throughout the British empire. It is a useful work of reference.

The Boston office of the Salem Iron Foundry Co., Inc., Salem, Mass., has been discontinued. Edward P. Brock formerly represented the Salem company with offices at 231 Congress street.

Move to New Quarters

The Pittsburgh Testing Laboratory, Pittsburgh, has moved to the new laboratories and office building located on Stevenson street at Locust. This building is a 5-story brick concrete structure, well lighted and ventilated so that determinations may be performed accurately. New accurate physical testing machines and chemical apparatus have been installed.

Test Nickel Anodes

Nickel anodes, such as are used for replenishing the solution in nickel plating, have been investigated by the bureau of standards. Determination of the relative behavior of different forms of nickel, such as electrolytic, rolled and cast nickel, in solutions used for electroplating was the purpose of the test. The experiment showed that the addition of chloride to the solution causes all types of anodes to dissolve with high efficiency. The chief difference in the

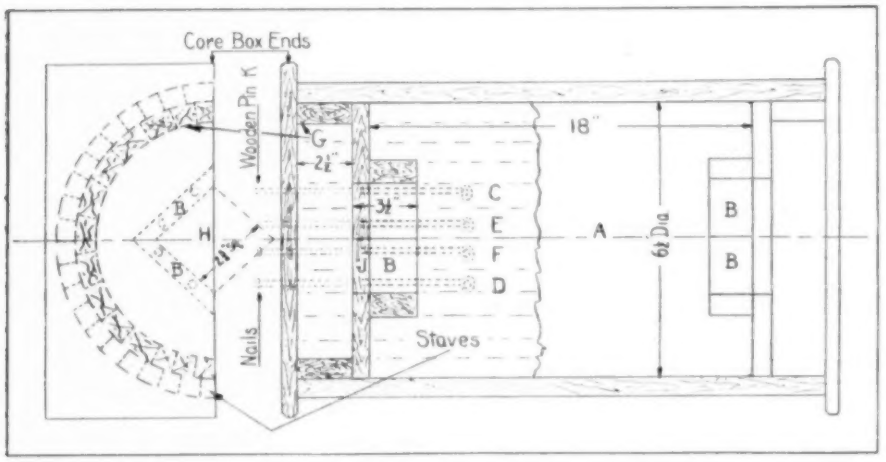
behavior of the different types of anodes was in the uniformity with which they dissolved. Anodes having a high carbon content were found to dissolve more readily than the more nearly pure forms of nickel, about 1.5 per cent of carbon found satisfactory. Appreciable amounts of sulphur and copper were found to have a harmful effect.

Study of Foundry Practice Essential

COREBOXES embracing some of the features shown in the accompanying illustration are made every day and furnish an interesting commentary on the fact that patternmakers do many things for which, if they were pressed, they would find it extremely difficult to furnish an explanation. The core shown is for a casting 18¾ inches long, 7¼ inches diameter and with an opening at each end 2¾ inches square reinforced by the flanges *B B*. The illustration shows the corebox as it first appeared and also as it appeared afterward when the additional prints were added to the ends. In the first instance the core prints on both pattern and corebox were made 2¾ inches square, the size of the required opening, and 3 inches long. In the second instance a large circular print was added to each end of both the pattern and corebox. This was found to distant foundries to be molded and they seldom see the resulting castings.

The flange *B B* in one piece was held in place loosely by wires and before many castings were made the holes in the end *J* became worn and as a result the coremaker was forced to hold the flange in place with one hand and ram the sand with the other. As the corebox first was assembled the wires holding the flange in place were inserted from the *inside*. After the core was rammed the coremaker had to dig down, pull the wires and then fill the excavations with sand and slick the surface before he turned the core over on a plate. After the corebox was removed the flange *B B* was drawn laterally from the end of the core.

Mistakes of the foregoing character resulting in loss of time in the core room and foundry are caused by lack of foundry knowledge on the part of the



END AND TOP VIEW OF COREBOX BEFORE AND AFTER EXTENSION PRINTS WERE ADDED TO THE ENDS

to be necessary due to the fact that the small prints would not support the weight of the core without a great deal of extra work on the part of the coremaker and molder. The old time foundryman might claim that the patternmaker should know all these things. Quite true, but how is he going to learn except through actual foundry experience or through frequent consultation with the foundryman? Comparatively few patternmakers have an opportunity of acquiring foundry experience during their apprentice days and afterward in many instances they work in shops where the patterns are taken patternmaker. Patternmakers who have no opportunity of studying foundry practice at first hand, and in fact those who have the opportunity, should study the trade journals devoted to the subject.

At the suggestion of the foundry foreman the small square 2¾-inch core prints were removed and replaced by round prints 2½ inches thick 5 inches diameter fastened centrally on the ends of the pattern. The corebox was changed by the addition of an extension at each end corresponding to the prints on the ends of the pattern. At this point it is pertinent for a man who has had no similar experience to inquire how the flange *B B* can be removed with this new addition to the core print blocking the way.

The flange pattern was cut through at the apex of the angle and after the corebox was rammed full of sand and scraped off flush, the two parts of the flange were extracted at a 45 degree angle. The cavity then was filled with dry sand and the core was rolled over on a plate. After the core had dried the sand filling the cavity was cleaned out.

In making the change the patternmaker retained the plan of inserting the wires holding the flange from the inside. At the suggestion of the coremaker the box was returned to the patternmaker to have the wires inserted from the outside. The patternmaker made the change but thinking to improve on the original plan he substituted long wooden pins for the wires. Dampne in the core room soon expanded the pins so they could not be used whereupon the coremaker threw them away and used some old spike nails which he found on the foundry floor. This replacement proved to be satisfactory.

Book Review

Nonferrous Metals and Minerals of the British Empire, by N. M. Penzer, 264 pages, 7½ x 10 inches; published by Ernest Benn Limited, Bouverie Street, London, and furnished by THE FOUNDRY, Cleveland and London, for $6 in U. S. A., and £1 1s 0d in Europe.

This is one of the 10 volumes on British Empire resources which is now being published under the auspices of the Federation of British Industries. In company with its companion volumes it is provided with a foreword by the Prince of Wales, and a general introduction by Sir Eric Geddes, president of the Federation of British Industries. A special introduction also has been written by Sir Richard Redmayne, chairman of the Imperial Mineral Resources bureau.

In this book complete data and statistics regarding the nonferrous metal resources of the British empire are presented, and it is believed this is the first time that this information has been brought together in con-

venient form in a modern publication. Thirty-three nonferrous metals and minerals are dealt with, including aluminum, antimony, chronium, cobalt, copper, fluorspar, gold, graphite, lead, magnesite, manganese, molybdenum, monazite, nickel, platinum, sulphur, tin, vanadium, zinc, etc. The book is divided into three parts, part I dealing with British Empire metal and mineral resources statistically; part II is geographical and descriptive; while in part III will be found a very complete bibliography of the existing literature dealing with nonferrous metals and minerals. This book, like the others in this series, is a valuable work of reference.

Nickel Promotes Density in Cast Alloys

BY W. M. CORSE

INCREASING use of nickel in brass and white metal is receiving considerable attention in the brass foundry business. The comparatively recent use of this element is not surprising, for it was in 1886 that nickel-steel first was described in technical papers. Nickel as a metal is familiar to the general public because of its extensive use in nickel-plated ware, but few realize that only 5 per cent of the total production of nickel is used for such a purpose.

Nickel forms alloys with a number of the more common metals. In combination with copper and zinc in brass it acts as a decolorizer and gives the class of alloys known as nickel-silvers, or German silvers. Its function here is two-fold—to decolorize and to increase resistance to corrosion.

Nickel in amounts from 0.05 per cent to 1.5 per cent will increase the density of a structure of any copper base composition containing upwards of 80 per cent copper. The density is increased progressively in proportion to the amount of nickel added up to 1.5 per cent. No improved effect is produced as far as density is concerned covering the range between 1.5 per cent to 5.5 per cent. From 5.5 per cent to 10 per cent the density of the structure again noticeably is improved. The latter range is now used to a great extent by companies that make castings which must withstand high pressure.

To keep the hardness constant, the tin content is lowered as the nickel content is increased.

Articles such as lubricators, injectors, inspirators, impellors, etc. that are tested from 125 to 350 pounds pressure, will show losses due to porosity ranging from 5 to 15 per cent, depending upon the nature of the castings. Special alloys which contain nickel have been the means of cutting these losses from 20 to 75 per cent.

By increasing the density of a structure, castings are made more serviceable for resisting pressure. The anti-acid properties of castings are also considerably improved, because it is well established that a close grained structure will resist the erosive and corrosive effects of acids far better than an open or porous structure.

Nickel is used in making several types of castings that come in contact with superheated steam. This development has taken place within the past few years, and it has been found that mixtures containing nickel from 8 to 10 per cent, with a tin content ranging between 6 per cent and 10 per cent, remainder copper, are the best mixtures to use for this class of work. This type of mixture is termed "nickel-bronze."

The use of small amounts of nickel with brass, or bronze mixture, will improve the tensile strength and elongation to a considerable extent. While there are no definite figures available of tests conducted to determine this particular point, it can be said that its use in amounts from 0.25 to 0.50 per cent will improve certain types of bronze mixtures to the extent of 15 to 30 per cent in tensile strength. Tests made with composition *G* bronze, copper 88, tin 10, zinc 2 per cent when cast into regulation test bars, had a tensile strength of 38,000 pounds per square inch with an elongation of 28 per cent. On remelting this alloy 0.35 per cent nickel was added, which raised the tensile strength to 50,000 pounds per square inch and the elongation to 55 per cent.

Experience has shown that practically every mixture used in common brass foundry practice may be improved in tensile strength and elongation by the addition of nickel in amounts from 0.1 to 6 per cent. The good effects produced are more pronounced as regards toughness.

Bearing bronzes of the copper-tin-lead type are noticeably improved by the use of nickel in amounts ranging from 0.25 to 3.5 per cent. More especially in that type known as heavy duty bearings such as are used in rolling mill work. A mixture composed of copper 80 tin 10 and lead 10 per cent, when modified to contain 1 per cent of nickel, will in most instances improve the tensile strength and elongation from 10 to 30 per cent.

By the use of an alloy containing 33 1/3 per cent each of copper, tin and nickel, no bad effects can be detected from the nickel addition. Its melting point is 1680 degrees Fahr., so that no overheating is necessary to get the nickel in solution.

Another important improvement in bearing mixtures containing nickel is that the resistance to compression is increased. This does not mean to imply that the plasticity of a structure is in any way impaired. On the contrary it is improved. We find that it is beneficial in this respect in that the mixture having it will not only bear a heavy load, but will withstand heavy shocks far better than a mixture without this element. Yet, the structure will be sufficiently plastic to make it readily conform to irregularities in a shaft or journal.

One of the outstanding benefits obtained in connection with the use of nickel in those types of bearing bronzes that contain high amounts of lead, is that the presence of nickel quickens the rate of cooling to such an extent that the prevalent condition known as *lead sweat* or *segregation* is reduced to a minimum, thus improving homogenity.

The principal thing that must be borne in mind, in connection with the use of nickel in all types of brass, bronze or aluminum mixtures, is its high melting point and refractoriness. We find it is preferable when using nickel in a mixture that it be introduced through the medium of a rich alloy, which melts about 1700 degrees Fahr.

Nickel now is playing an important part in the aluminum alloy field. The principal advantages in this respect is that from 1 to 3 per cent nickel densifies the structure, producing a fine surface which is more capable of taking a high polish and holding the luster for a considerable time.

It has been found that small percentages of nickel added to aluminum mixtures containing magnesium and manganese respond readily to heat treatment and has a noticeable effect in increasing tensile strength as well as the toughness.

Doubtless many other uses for nickel-bearing alloys will suggest themselves, but the few instances given will illustrate the benefits to be derived in some instances and point the way to others.

Abstracted from a paper presented at a meeting of the Metropolitan Brass Founders association, New York. The author is consulting metallurgist to the International Nickel Co.

As evidence of the increasing use of nickel in brass, the ingot manufacturers find it difficult to obtain raw material which does not contain this element. In many cases it is found beneficial to have this element present in the ingot.

Cylinder Develops Blow Holes Near Gate

Question: We are enclosing a blue print of a cylinder 32 inches long with a 9⅝-inch bore provided with a large and small rectangular flange respectively at either end and with several brackets and other attachments that render it a comparatively complicated molding job. We have made two patterns split horizontally through the center, the second pattern split on a plane at right angles to that observed on the first. The mold is poured through a horn gate entering the bottom of the smaller flange and we use a perforated core for a skim gate. Blow holes always show at the point where the metal first touches the core. Iron of the following analysis is used in these castings: Silicon 2.00 to 2.10 per cent; sulphur 0.07 to 0.10 per cent; phosphorus 0.40 to 0.50 per cent; manganese 0.60 to 0.70 per cent; total carbon approximately 3.50 per cent. We shall appreciate any information that will tend to improve our practice.

Answer: Without actually seeing a mold made we only can venture a guess at the probable cause of your trouble. Your molding practice seems to be all right although it seems to be immaterial whether the pattern should be split the first way or the second. Several dry sand cores are required to form the hopper shaped end in either case. The analysis of your iron is quite satisfactory for castings of that character. If the blow holes appeared all over the casting you reasonably might assume that one of three causes was to blame: (1) the iron might have been oxidized in the furnace; (2) the mold or cores might have been damp; (3) the cores might have been too hard and dense for the free egress of the gas generated.

However, since the blow holes are localized in the vicinity of the gate we are inclined to the opinion that you probably are using a horn gate core that is too hard; or else a core made from sand bonded with a water soluble binder. A core of the latter character will absorb moisture from the sand and cause the iron in the immediate vicinity to boil thus causing blow holes. In the foregoing we assume that the mold is made in green sand. If the mold is skin dried with a torch, it is essential that no wet blacking should be applied to the gate. The molder may apply the flame at the bottom and see it appear at the top, but that does not mean that there is a flame inside the gate. The air and oil pass through the gate and ignite again upon striking the open air. No heat is developed on the inside of the gate and the blacking does not dry. As a result a violent ebullition takes place later while the iron is entering the mold.

H. N. Schreuder has been appointed eastern sales representative of the National Engineering Co., Chicago. Mr. Schreuder will be located at 50 Church street, New York. R. J. Richards, who formerly operated in that territory, has been transferred to the Pittsburgh district as sales representative.

Alloys Make Permanent Molds Success

In a recent speech before the Pittsburgh Foundrymen's association Jesse L. Jones, chief chemist of the Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa., stated that considerable interest is being shown by many users in permanent mold castings. These castings cannot be cast quite as closely to size as die castings, but they are much superior to sand castings in this respect. In the case of certain alloys the permanent mold casting is competing successfully with the sand casting and its quality is better than that of the sand casting as regards physical characteristics. Die castings, especially brass die castings contain numerous blowholes. Superficially, the castings may appear perfect, and for many purposes they may prove entirely satisfactory. However, when cross-sections are made, the defects are evident. Permanent mold castings, on the other hand, are free from blowholes. Shrinkspots and draws must be guarded against. This usually can be taken care of by careful design of the mold and casting so that the metal will be set from the bottom up. Iron-aluminum bronze is one alloy that lends itself well to casting in permanent molds. It has the strength of steel and the castings have a beautiful golden color. Manganese bronze on account of its low melting point also casts well. However, the greatest development in permanent mold castings is in the various aluminum alloys, especially the 95 per cent aluminum and 5 per cent silicon alloys.

Defines Monazite Sand

To the Editor:

We would like to make some observations in connection with the statements concerning the use of zirconium oxide which appeared in THE FOUNDRY April 15, page 294, in an article on "Making Long Life Molds" by Oliver Smalley. The author stated that monazite sand is a silicate of zirconium. This is not correct according to our nomenclature, since monazite sand is essentially a phosphate of cerium, lanthanum and didymium with a small per-

centage of thorium. After the extraction of the thorium, the cerium remains as a by-product, generally in the form of the carbonate together with other impurities present in the sand.

Silicate of zirconium is an entirely different mineral. It is true that it occurs in the form of sand, and often is separated from monazite by electromagnetic concentration prior to the chemical treatment of the sand by the extraction of the thorium. Zircon, the mineralogical name for silicate of zirconium, is a refractory substance, but tests have shown that it is in no way superior to natural zirconium oxide.

H. C. MEYER, Vice President,
Foote Mineral Co.,
Philadelphia.

How and Why in Brass Founding

By Charles Vickers

Core Seam Leaves Fin in Impeller Casting

In making impeller cores it is necessary to paste the two halves together and at the seam where the connection is made the metal burns through the paste and forms a fin on the inside of the impeller which is objectionable. We desire to paste the cores together in such a way that the seam will be entirely obliterated and form an impervious surface through which the brass will not penetrate.

Usually when the two halves of a core are pasted together a thin film of the paste exudes through the seam, and if the joint is then rubbed gently with new molding sand the seam will be solidly filled. The molding sand should not be rubbed on the outer surface of the core and be permitted to remain, but should be brushed off with a suitable soft brush. After the core is dried and still warm, coat the seam with a paste of a good grade of plumbago mixed wtih molasses water. This should be rubbed on with the fingers and in places inaccessible to fingers make the paste into a heavy cream and brush on the joint. Other binders can be used in place of molasses water if desirable, such as glue, gum, and silicate soda. The binder must be of a nature for the bronze to lay to it quietly, and not permit the plumbago to flake away.

Iron Appears in Metal for Bronze Gears

We are making small gear blanks of a mixture of copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent. We experience considerable difficulty because one side of the blank carries hard spots. This side is the part cast in the cope, the drag side of the castings is perfectly soft and machines easily. However, the upper half is hard and brittle. We melt in oil-fired crucible furnaces and pour at 1800 degrees Fahr.

The hard spots appear to be caused by unalloyed iron as this element is easily found by analysis in the metal comprising the cope side of the casting. The remedy is to be careful about iron getting into the mixture as it is not to be expected that it will go into solution in the presence of 10 per cent lead.

The casting is massive, therefore, it remains liquid in the mold sufficiently long for the iron to float to the upper surface. Thus one face of the gear is soft and easily machines, while the other face is filled with hard spots and unmachinable. Judging from the color of the skin of the casting, which is an orange, no iron should be present *according to former beliefs, but chemical* tests reveal its presence, and the fine color merely indicates the iron is not in solution. Otherwise, the color of the surface of the casting would be black, or dark, and unsightly, and shrink cavities in all probability would be found.

All that is required to avoid this trouble is care in the selection of the metals forming the alloy.

Brass Packing Rings

We have an order for brass packing rings which must be made of a soft alloy. Can you suggest a suitable alloy?

Packing rings frequently are made from a mixture consisting of 50 per cent copper, and 50 per cent lead. The standard method of holding the lead from separating is to add roll sulphur, about one per cent. Lead sulphide, or galena also is used, and frequently admixtures of sulphates, such as plaster of Paris mixed with salt and soda ash. A little experimental work may be necessary to make the mixture.

Making Brass Bushings

Kindly tell us what mixture of brass is best suited for bushings of automobile piston pins.

The following alloy finds extensive use for the purpose mentioned:

ALLOY FOR BUSHINGS

	Per cent
Copper	90
Tin	6.5
Zinc	2
Lead	1.5

Spongy Bearing Castings

We have experienced considerable trouble with half bearing castings showing spongy after they are turned off. Before machining they appear good, clean castings. We cast them bearing down in green sand and the holes we believe are caused by a boiling effect caused by the core. We have changed the sand with no better results, and have tried sharp sand bonded with linseed oil with results the same. We have also tried dextrin and molasses as binders, but the best results are obtained with green sand cores. The cores in every case were well vented and the gas seemed to escape freely when the molds were cast. The composition of the alloy is copper 80.5 per cent, lead 9.5 per cent, tin 10 per cent, and the melting is done in tilting coke fired furnaces of 400 pounds capacity.

It is customary with the alloy in question to add a certain amount of phosphor copper as a so-called *deoxidizer*. Whether oxides have anything to do with the castings coming spongy or not, generally the metal so treated is more certain to produce sound castings than metal not so treated. It would be advisable therefore, to make an addition of four ounces of phosphor copper to each hundred pounds of the alloy, which should produce sound castings. The experiments with varying the molding methods show the molds are not to blame as much as the metal. It fails to lie quietly on its sand bed in the mold, but simmers and raises steam or gas which is held in the casting. A little *poison* like phosphor copper frequently corrects this condition. It also may be corrected by melting under a flux such as can be obtained from advertisers in THE FOUNDRY. The addition of 2 per cent of zinc to the alloy, and deducted from the copper content is another easy way to correct the trouble, and it will not harm the alloy from a bearing standpoint, nor will it render the alloy any less resistant to the action of acids. The bearing part of the mold should not be packed hard, and should be well vented.

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Acid Steel Again Takes Lead

STEEL castings production in 1923 broke two records, closely approached a third and developed a metallurgical enigma. The total of steel castings reported by the American Iron & Steel Institute is the largest ever recorded, reaching 1,458,031 tons, or almost 41 per cent more than the 1922 total of 1,034,508 tons. The remarkable production of 1923 is the largest noted since figures first were compiled in 1909, exceeding the peak war year, 1917 with its 1,441,407 tons.

The second phenomenal increase to a total surpassing all previous production is noted in electric furnace steel castings which last year reached 235,958 tons, surpassing 1922 with its 154,982 tons by 80,976 tons and giving an increase of more than 52 per cent. The highest previous production of electric steel castings was noted in 1920 when the total of 155,196 tons established a high mark and excelléd the previous year by almost 39 per cent.

Open hearth castings production also registered a strong gain, the total of 1,152,609 tons for 1923 exceeding the previous year's total of 830,748 tons by almost 39 per cent.

Open hearth steel production over the past few years presents an interesting riddle. In the early days of recorded statistics, basic steel castings output exceeded acid steel, and in 1916 the former constituted 52 per cent of the total of the open hearth product. Then the latter gained the lead and maintained it consistently until 1921, when of the total of 434,445 tons of open hearth steel castings, 217,957 tons were made in basic lined furnaces and 216,488 tons in the acid units. The following year seemed to support the theory that basic had taken the ascendancy and would maintain it, for of the total of 830,748 tons of open hearth steel castings made, slightly over 51 per cent were of basic metal.

At this time the opinion was advanced that basic practice had taken the lead permanently. Basic steel does not require the class of selected material demanded in acid practice and it does not require as high a proportion of pig iron as the latter process. Further, it is possible to meet specifications with basic open hearth steel even with the lower requirements as to charges.

The totals for 1923 challenge the theory that basic practice will maintain the lead and reverse the comparative conditions. Of the total of 1,152,609 tons, 581,299 tons or over 51 per cent were made in acid lined furnaces. It has been suggested that with operating costs fairly even, the acid lining costs less and lasts longer. Further, the disparity between scrap and pig iron prices was less last year than in the two previous years as may be noted from the following table:

Year	Total O-H castings	Basic steel castings	Acid steel castings	Basic iron *Pittsburgh	Heavy scrap **Pittsburgh
1921	435,445	217,957	216,488	$21.47	$13.60
1922	830,748	425,981	404,767	24.02	17.41
1923	1,152,609	571,310	581,299	25.56	20.40

*Compilation, W. P. Snyder & Co., Pittsburgh.
**_Iron Trade Review_, Statistical Annual.

It will be noted that the difference between the price of iron and that asked for heavy melting scrap has grown less. In fact, at one time during the past year heavy melting steel was selling at $21.00 Pittsburgh and basic pig iron which was a drug on the market for several months was bringing only $19.50. Probably this condition serves to explain the swing back toward larger acid steel production.

Bessemer steel castings totaled 67,512 tons in 1923 an increase of 42 per cent over the previous year, closely paralleling the growth in output of all steel castings.

Trade Outlook in the Foundry Industry

FOUNDRY operations have sagged, in many cases below the level of activity noted in the industries which contribute directly to castings order books. This particularly is true of automotive shops, where deliveries have been curtailed almost to the zero point, although in many cases the automobile plants themselves are working on reduced schedules. Obviously, stocks of castings which in the past have not been maintained far in advance of immediate needs, will not suffice to sustain even this restricted output of cars. Many predict the turning point leading to better foundry production will fall within the next thirty days.

No Alarm Expressed

Little apprehension is expressed, and almost without exception manufacturers believe that the present lull is the result of a mental condition, the applying of lessons learned in the depression of 1920-1921, rather than an actual industrial crisis. Demand and consumption have not suffered. Retail sales are unimpaired, particularly as regards necessities and many of the luxuries which have won their way into the necessity class. Better conditions obtain in marketing of automobiles. Electrical household sundries are selling freely. Building construction has encountered a setback, but residences still are in demand in the larger centers, and commercial type building construction is proceeding. April building awards in 27 northeastern states showed a decline of 7 per cent when compared with March, but the total was only 3 per cent less than in April 1923. Contemplated new work declined 10 per cent in April, and building costs show little tendency downward. Despite these factors, plumbing goods foundries are fairly active, due probably to delayed orders accruing from the phenomenal March building awards. Sales of plumbing brass goods in April surpassed those of the same month last year.

Prices for Raw Material for Foundry Use

CORRECTED TO JUNE 6

Iron		Scrap	
No. 2 Foundry, Valley	$20.00 to 21.00	Heavy melting steel, Valley	$19.50 to 20.00
No. 2 Southern, Birmingham	20.00 to 21.00	Heavy melting steel, Pitts.	15.50 to 16.00
No. 2 Foundry, Chicago	22.00 to 22.50	Heavy melting steel, Chicago	13.75 to 14.25
No. 2 foundry, Philadelphia	21.89 to 23.26	Stove plate, Chicago	15.50 to 16.00
No. 2 Foundry, Buffalo	19.50 to 20.00	No. 1 cast, Chicago	19.25 to 19.75
Basic, Valley	20.00 to 20.50	No. 1 cast, Philadelphia	17.00 to 18.00
Basic, Buffalo	19.50 to 20.00	No. 1 cast, Birmingham	18.00 to 19.00
Malleable, Chicago	22.00 to 22.50	No. 1 cast, Buffalo	17.50 to 18.50
Malleable, Buffalo	19.50 to 20.00	Car wheels, iron, Pittsburgh	15.50 to 16.00
		Car wheels iron, Chicago	16.50 to 17.00
Coke		Railroad mal., Chicago	17.50 to 18.00
Connellsville foundry, coke	$4.25 to 5.00	Agricultural mal., Chicago	16.50 to 17.00
Wise county foundry, coke	4.00 to 5.00	Malleable, Buffalo	19.00 to 19.50

Pig Iron Declines

During May, pig iron production registered another marked drop, according to statistics compiled by the *Iron Trade Review*. The total for May was 2,631,248 tons compared with 3,226,107 tons for April. The May figure is the lowest point in the past 18 months, being 18.4 per cent less than April, and with the exception of the 616,366 ton loss in October, 1919 during the steel strike, the past month showed the most decided slip in recent history. Merchant iron production in May totaled 659,221 tons, compared with 708,151 tons made in April. This shows a loss of 48,930 tons or 7.4 per cent. On a daily average basis, May showed a production of 21,256 tons per day against 23,605 tons for April, a loss of 2340 tons. The total number of furnaces in blast on the last day of May was 188, compared with 234 on April 30, and 269 on March 31. The May loss in active furnaces was 46, bringing the total loss for the past two months to 81. During May, one merchant stack went in blast and nine were blown out, giving a net loss of eight for the month.

Buying Increases

Despite the stagnation reflected in pig iron production, buying picked up during May. The larger radiator, cast pipe and railway foundries contracted for a total of more than 100,000 tons of iron. Other foundry interests, confident that the bottom in price was approached or apprehensive of inadequate stocks purchased against third quarter delivery. Gray iron jobbing foundries have been operating practically on a day to day basis and have bought only for immediate needs. Malleable operations are spotty. Railway foundries making heavy malleables, such as draw gear and couplers are active and fair production is maintained on other sundries such as journal boxes and car fittings. Automobile manufacturers have cut orders for malleable castings with immediate effect upon the foundries making this class of castings. According to the department of commerce, malleable foundry operations during April were at 53.7 per cent of capacity, compared with 66.5 per cent for the preceding month. This is the lowest point in the past four months, but is ahead of November and December, 1923. Orders for sanitary ware declined during April. A total of 97,606 baths were ordered against a shipment of 103,184 and unfilled orders for 239,118. The previous month showed 130,375 ordered, 116,917 shipped and unfilled orders amounting to 245,921. April was the first month since last November in which the orders have dropped below the shipments. Orders for lavatories, sinks and miscellaneous enameled sanitary ware showed a similar disparity when compared with April shipments. Employment in many lines has decreased during the past month, falling to the same level reported last November according to compilations by the federal reserve board. However, employment agencies are not besieged by those out of employment, and no excessive crowds are encountered when works advertize for men. This would tend to indicate that even those out of employment consider or have been advised that the condition is temporary. Automobile production has been cut from 25 to 50 per cent.

Nonferrous Prices

New York quotations on nonferrous metals, according to the *Daily Metal Trade* of June 6, follow: Casting copper, 12.37½c to 12.50c; electrolytic copper, 12.75c to 12.87½c; Straits tin, 42.12½c; lead, 7.12½c to 7.17½c; antimony, 8.25c; nickel, 30.00c; aluminum, No. 12 alloy, remelt, 21.00c to 22.00c., Zinc is 5.85c to 5.90c, E. St. Louis, Ill. Average prices for May follow:

(New York Quotations)

Castings Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.67	13.057	7.307	44.112	8.55	27.00	5.81

Comings and Goings of Foundrymen

JOHN BIBBY, for the past seven years superintendent of the Anthes Foundry, Ltd., Toronto, Ont., has been made superintendent of the Forwell Foundry Co., Kitchener, Ont. Mr. Bibby was born at Wigan, Lancashire, England, in 1876 and learned the molding trade with the Wigan Coal & Iron Co., later holding a position with the Hadfield Steel Works, Sheffield. He came to Canada in 1903 and secured employment with the Smart-Turner Machine Co., Hamilton, Ont. Later he held positions with the Toronto Furnace & Crematorium Co., the Dyment Gas Producer Co., Barrie, and later went in business for himself. The foundry was partially destroyed by fire Feb. 19, 1917, and Mr. Bibby accepted the position with the Anthes foundry.

L. W. Fuller, formerly connected with the National Foundry Co., Erie, Pa., has accepted a position as forman of the Mackintosh, Hempill & Co., Midland, Pa.

W. M. Corse, National Research council, Washington, has accepted an invitation to deliver the third annual autumn lecture at the meeting of the British Institute of Metals, London, England, Sept. 8.

Carl Stenburg, who for the past four years has been general foreman for the American Brake Shoe & Foundry Co., has been made general superintendent of the Railway Materials Co., Toledo, O.

Nathan C. Harrison, treasurer of the Harrison Supply Co., Inc., Boston, sailed June 10 for Europe. He will visit various agencies in England, Scotland, France, Germany, Belgium, Holland, Norway and Sweden.

Fred Cowen, formerly with the Osborn Mfg. Co., Cleveland, now is associated with the Werner R. Thompson Co., Detroit. Mr. Cowen is the newly elected treasurer of the Detroit Foundrymen's association.

John Haag, for the past 12 years assistant superintendent and for the last year superintendent for the Aultman & Taylor Machine Co., Mansfield, O., has in co-operation with his brother, established the Progress Foundry & Mfg. Co., 3861 E. 93rd street, Cleveland.

Joseph Fabian and P. F. Devany have opened a small brass and aluminum foundry under the name of Hunter & Co. in the rear of 1907 Indiana avenue, Chicago. They have enlarged their equipment by the addition of a 300-pound furnace.

H. L. Sheaffer has been made plant superintendent for the Hadfield-Penfield Steel Co., Bucyrus, Ohio. Mr. Sheaffer for a unmber of years has been connected with the American Steel Foundries serving at Granite City, Ill., and Alliance, Ohio. He was assistant foreman of the foundry at Alliance.

H. D. Miles, president of the Buffalo Foundry & Machine Co., Buffalo, N. Y., is in London for the purpose of transacting certain business connected with nonferrous alloys. Mr. Miles represented the American Foundrymen's association, of which he is a past-president, at the Newcastle convention of the Institute of British Foundrymen, June 4 to 6.

Arthur G. Hopcraft, purchasing agent of the Ferro Machine & Foundry Co., Cleveland, was elected president of the National Purchasing Agents association at the recent convention in Boston. Mr. Hopcraft was vice president of the association last year. He was general chairman of the 1923 convention held in Cleveland, and served two terms, in 1922 and 1923, as president of the Cleveland Purchasing Agents association. Mr. Hopcraft has been connected with the Ferro company for the past 10 years.

C. J. Houck, recently appointed foundry superintendent of the Des Plaines Foundry Co., Des Plaines, Ill., has had a wide and varied experience in gray iron casting production. He has been employed by the Free Sewing Machine Co., Rockford, Ill., Flint & Walling Mfg. Co., Kendallville, Ind., Advance Rumeley Co., LaPorte, Ind., and the King Sewing Machine Co., Buffalo, N. Y. In addition he has worked in various malleable shops such as the Rockford Malleable Co, Rockford, Ill., Timken Malleable Co., Canton, O., and Grabler Mfg. Co., Chicago.

D. A. Potter, who recently was made assistant general superintendent of the American Range & Foundry Co., Shakopee, Minn., has been continuously in the foundry business since he was 13 years of age. He first was apprenticed with the Northern Pacific Ry. Co. at their Brainerd shops working several years after completing his apprenticeship. From 1892 to 1900 Mr. Potter was employed as a molder for the St. Paul Foundry Co., leaving to take charge of the Chas. A. Sackney Co. foundry. Later he was at the Chicago plant of the Allis-Chalmers company, Chicago, leaving to accept a position with the Watts-Campbell Co., Newark, N. J. In 1910 Mr. Potter became associated in the organization of the Gas Tractors Foundry Co., Minneapolis, being superintendent of that establishment. Later he became president and general manager of the Northwestern Steel & Iron Corp., Minneapolis, resigning in 1919. Mr. Potter was associated with the Gray Foundry Co. from that time until he became assistant general superintendent of the American Range & Foundry Co.

Takes Over Plant

The foundry formerly owned and operated by the W. L. McCullough Co., Ypsilanti, Michigan, has been taken over by the Huron Gray Iron Foundry Co. of that city. A. A. Corbeille is general manager and secretary.

Elect Vice President

L. D. Albin, formerly general sales manager of the Ingersoll-Rand Co., New York, has been elected vice president in charge of European sales of that company. D. C. Keefe, formerly assistant general sales manager, has been appointed to succeed Mr. Albin as general sales manager.

Receivership Lifted

The American Bronze Corp., Berwyn Pa. recently has been taken from the receiver ship under which it has been operating since Aug. 8, 1923. The business is now restored to its stockholders, with the following officers in charge: E. G. Anderson, president; Wm. F. Fisher, vice president; G. Willard Frame, treasurer; John C. Smith, secretary.

A program of investigation in metallurgy in co-operation with the United States Bureau of Mines has been adopted by the Carnegie Institute of Technology, Pittsburgh. Action to initiate the metallurgical research has been taken by the establishing of four fellowships dating from August 1924. The fellowships will be awarded to college graduates, the appointees to register for the degree of master of science.

Large Gathering Marks British Convention

(By Special Cable)

The 1924 meeting of the Institute of British Foundrymen held at Newcastle-on-Tyne, June 4 to 6 was the largest and most enthusiastic held since the inception of the organization. R. O. Patterson, Smith-Patterson, Ltd., Blaydon-on-Tyne, who was elected in Birmingham last year was installed as president. Other officers who have assumed charge of the affairs of the institute include J. Cameron, Cameron & Robertson, Kirk intilloch, senior vice president and Vincent Faulkner, editor, The Foundry Trade Journal, junior vice president F. W. Finch, treasurer and W. G. Hollinworth, secretary were re-elected to their respective offices.

Oliver Stubbs, who during his term as president of the institute, visited the United States and was the guest of the American Foundrymen's association was the recipient of a unique honor in being made on honorary life member of the Institute of British Foundrymen.

A special telegram of greeting was sent to G. H. Clamer, Ajax Metal Co., Philadelphia, president of the American Foundrymen's association which organization was represented at the Newcastle meeting by its past-president, H. D. Miles, Buffalo Foundry & Machine Co., Buffalo.

Great Amounts of Copper Used in Automobiles

In its annual survey of the automotive industries the Copper and Brass Research association places total 1923 consumption of copper in cars, trucks, and accessories at 170,000,000 pounds. This is an increase of 61,720,000 as compared with 1922 and of 90,000,000 over 1921.

Copper content of the American car or truck varies all the way from 18 to 750 pounds. This total consumption indicated includes not only the amount of metal carried by the finished stock car, but also the copper used in repair parts, replacements, special body work, accessories and in the increasing number of closed body models, and copper in alloy as well as the pure metal.

Removes to New York

D. L. Harris, assistant sales manager of the W. W. Sly Mfg. Co., has transferred his office from Cleveland to 50 Church street, New York, where he will have charge of sales in eastern New York and New England. D. P. Carter continues as district manager and will have charge of sales in New York City, New Jersey, eastern Pennsylvania, Maryland and Delaware.

Moves Office

The Austin Co., Cleveland, has removed its Chicago district offices from the Continental & Commercial National Bank building to the Burnham building, 160 North LaSalle street, Chicago.

Purchases Land

The Inland Engineering Co. has purchased land and buildings with railroad facilities at 505 Kensington avenue, Chicago, and the offices of the company hereafter will be located there.

Appointed Distributor

The Dominion Foundry Supply Co. Ltd., 185 Wellington St., Montreal, Quebec, Canada has been appointed distributor for the fluxes manufactured by the Cleveland Flux Co., Cleveland, Ohio.

Seeks Steel Rings

Swister & Co., 47 Front street, Port Jervis, N. Y. desires to obtain cast steel furnace casing rings.

Takes Over Plant

The Rockingham Foundry Co. has taken over the plant of the former Portsmouth Foundry Co. at Portsmouth, N. H., and will operate it as a jobbing foundry.

Obituary

Frank C. Caldwell a director of the Link-Belt Co., Chicago, since the purchase of the H. W. Caldwell & Son Co. by the Link-Belt Co. in 1921, died on the morning May 15, while on the way to the bank. Mr. Caldwell was born in Indianapolis in 1866, and went to Chicago in the early eighties to complete his education at Union College of Law. He practiced law until 1892 when he became vice president of H. W. Caldwell & Son Co. He became president in 1908. Mr. Caldwell was president of the National Metal Trades association in 1911-12, and served as treasurer of the association in 1912-22.

George Edward Long, formerly vice president, manager and a director of the Joseph Dixon Crucible Co., died May 21 at Ridgewood, N. J. Mr. Long was 74 years of age. He entered the Dixon company's employ as a messenger boy in 1878 and retired as vice president in 1920.

Henry Johnson, for many years foundry superintendent for the Bullard Machine Tool Co., Bridgeport, Conn., died recently at his home.

John H. Morton, purchasing agent of the Malleable Iron Fittings Co., Branford, Conn., died Wednesday, May 7.

Albert F. Ashenbaugh, aged 63, superintendent of the H. M. Meyers Shovel Co., Beaver Falls, Pa. branch of the Ames Shovel & Tool Co., Boston, died May 12 in his home at New Brighton, Pa. He was born in old Allegheny City and entered the employ of the H. M. Meyers Co. at 14 years of age, rising steadily in their employ until he became superintendent 25 years ago.

William D. Miller, who had been connected with the Lewis Foundry & Machine Co., Pittsburgh, for a number of years as roll advisor and salesman, died May 13 of pneumonia. Mr. Miller was known to a wide circle of friends in the steel business.

George H. Gellert, president and treasurer of the Nichol-Straight Foundry Co., Chicago, and vice president of the York Foundry & Engine Works, York, Neb., died at his home in Chicago, May 11. He had been connected with the Nichol-Straight foundry for eight years. He is survived by a widow and two sons.

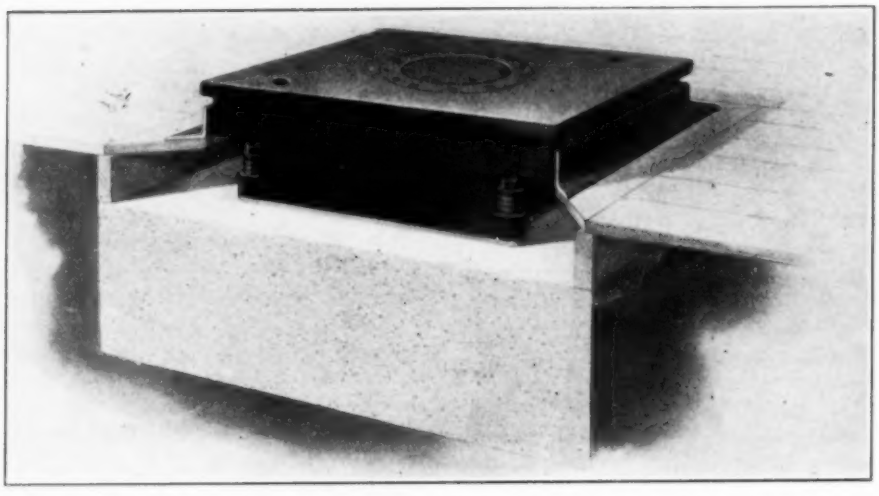
James H. Beans, president of the J. H. Beans Foundry Co., Martins Ferry, O., died at his home in Wheeling, W. Va., May 11. Mr. Beans was born Aug. 8, 1873 at Braddock, Pa. His parents moved to Steubenville, O., when he was 4½ years old. He received his education at Steubenville and later served as a civil engineer on the Pennsylvania railroad. In 1893 he went to Wheeling, a short time later becoming associated with the Center Foundry Co. Fifteen years ago he purchased the William Mann Foundry at Martins Ferry.

Office Is Moved

The office of the Ohio State Foundrymen's association has been removed from the Century building to 5713 Euclid avenue, Cleveland. Arthur J. Tuscany is secretary-manager.

Set Convention Date

It has been decided that the annual convention of the Association Technique de Fonderie de France will be held this year in Paris on Nov. 21 to 23.



THE PISTON AND CYLINDER OF THE JARRING MACHINE ARE CAST SEPARATELY

Constructs Heavy Duty Suspended Grinder

A heavy-duty, ball-bearing, swing grinder which may be used in the cleaning room of the foundry, has been developed by C. A. Fox, Oakmont, Pa., and is being distributed by the Desmond-Stephan Mfg. Co., Urbana, O. The new machine is shown in the accompanying illustration.

Power is furnished by an electric motor located at the opposite end of the frame from the grinding wheel. The device is suspended from the ceiling on a hook, the point of suspension on the frame being such that the motor and grinding wheel are balanced, thus making it easier for the operator to control and direct the machine. The wheel is driven by an endless belt from the motor, which has a capacity of 15 horsepower.

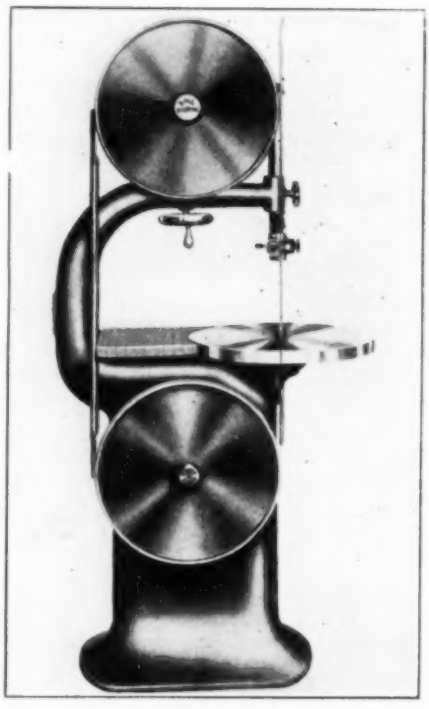
Heavy-duty, ball bearings are used throughout. The bearings are enclosed in a dust-proof case inside the wheel housing and packed in grease. A 24 x 3-inch grinding wheel is used, running at a speed of 9000 feet per minute. It is necessary to remove only two bolts and the flange nut when changing wheels.

Develops Enclosed Type Jarring Machine

The Tabor Mfg. Co., Philadelphia, has introduced a new, plain jarring machine in which all parts are enclosed. The piston and cylinder are cast separately, the former being bolted to the base. Two corner guides, located diagonally opposite, are enclosed and protected from falling sand. The corner guides have special bearings.

A confined, cork buffer is located in the bottom of the cylinder, against which the piston strikes just before the jarring table strikes against the striking face of the base. It is claimed that in addition to imparting the required resiliency, the cork buffer is in effect a spring that starts the table upward after the succeeding blow. The machine is provided with a internal, high-speed, jarring valve made by the company. This valve is located in the bottom of the jarring piston, which, it is claimed, eliminates dead air space.

The jarring piston and the jarring valve are the only two parts requiring lubrication and oil is introduced to these through oil pipes provided on the operating stand. The machine is controlled by a single valve mounted on the operating stand and located conveniently. The machine is built in seven sizes ranging in table size from 28 x 40 inches to 68 x 80 inches.



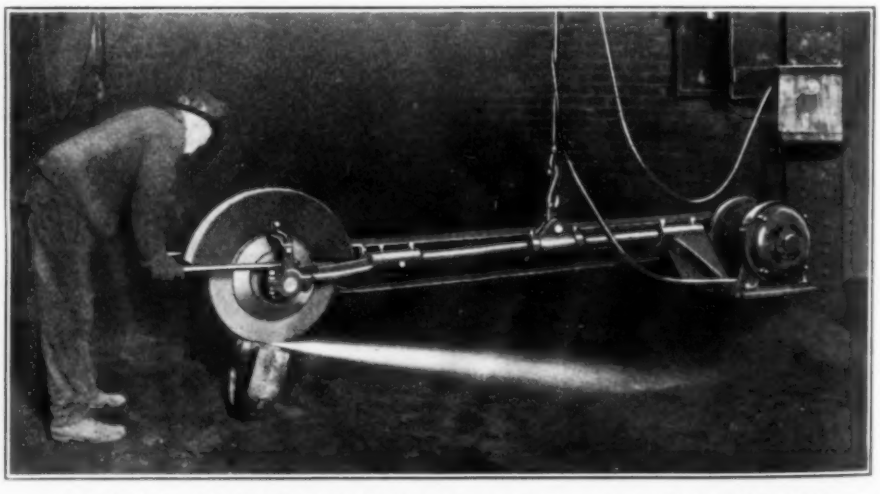
BAND SAW IS CONVERTED INTO A DUAL TYPE MACHINE BY TWO SPEED ARRANGEMENT

Builds Two Speed Saw

The Porter-Cable Machine Co., Syracuse, N. Y., recently has adopted a two speed arrangement for a 20-inch motor driven band saw. This combination converts the machine into a dual type saw which is adaptable to wood or light metal cutting. The regular speed for cutting wood is 3000 feet per minute. To cut metal, a knob on the gear case may be shifted. This changes the gears and reduces the speed of the saw by half.

The motor is housed in the base and is entirely enclosed to keep the dust in the patternshop or cleaning room from the moving parts of the machine. The drive mechanism runs in oil and is ball bearing throughout. The two speed arrangement is intended to add to the usefulness of the machine making it suitable for aluminum and brass cutting, sawing hard rubber and fiber in scroll designs, as well as wood shop work.

L. A. Marshall, for a number of years service manager of the Industrial Works, Bay City, Mich., now is connected with the Chicago office of this company as sales engineer.



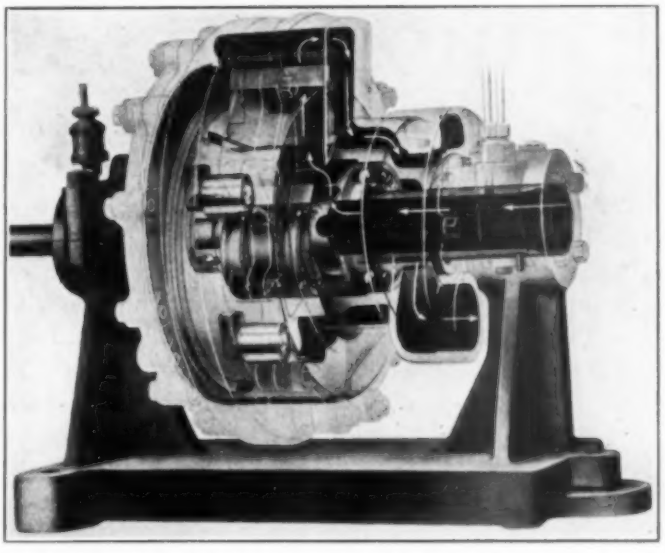
SUSPENDED GRINDER FINDS USE IN THE FOUNDRY CLEANING ROOM

Vacuum Pump Adapted to the Foundry

A rotary-piston type, dry vacuum pump, which may be adapted to the handling of sand by the vacuum system in foundries, recently has been introduced by the Chicago Pneumatic Tool Co., New York. As shown in the accompanying illustration, the pump has two main moving members consisting of a rotor or piston and case, which revolve at the angular velocity one within the other about the same shaft.

The rotor is given a rolling motion as it describes an eccentric at each revolution since it is smaller in circumference than the case and is set off center to the axis of the case. This movement maintains at all times a crescent shaped displacement of fixed capacity. The displacement is divided by a brass rotor vane into intake and exhaust spaces which change from zero to maximum volume throughout each pumping revolution.

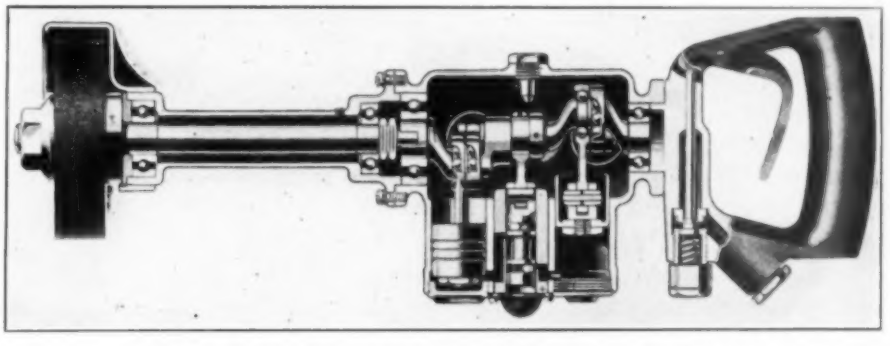
All working parts, ball bearings and bronze bushings with the exception of the drive shaft ball bearings which turn in compressed grease are lubricated by a forced feed system. Short overall dimensions allow the installation of this pump in limited space where it may be driven by an electric motor or from a line shaft.



VACUUM PUMP MAY BE USED IN THE FOUNDRY FOR HANDLING SAND

Introduces a Portable Pneumatic Grinder

The Cleveland Pneumatic Tool Co., Cleveland, has designed a new, portable, air-operated grinder. The machine weighs 12 pounds. An air motor drives a 6-inch emery wheel at 4600 revolutions per minute. The accompanying illustration shows a section of the machine. An arbor extension covered by a housing is used as the forward handle. The arbor is connected directly to the crank and is mounted on ball bearings at both ends. The single-piece, connecting rods contain ball races which operate directly on the crank. The races as well as the bearings on the crank and arbor are open to continuous lubrication both in the crank chamber and in the forward quill housing. Four types of throttle handles are furnished, namely an enclosed type with outside or inside throttle levers, a straight handle with snap throttle lever and a straight handle with a twist throttle sleeve. The body is split at the center which permits the removal of the entire crank assembly without disconnecting pistons or valves from the crank. The piston cups are screwed to the piston sockets and each is reenforced by a lock nut at the base of each cup. The connecting rods are attached to piston sockets by a floating wrist pin.

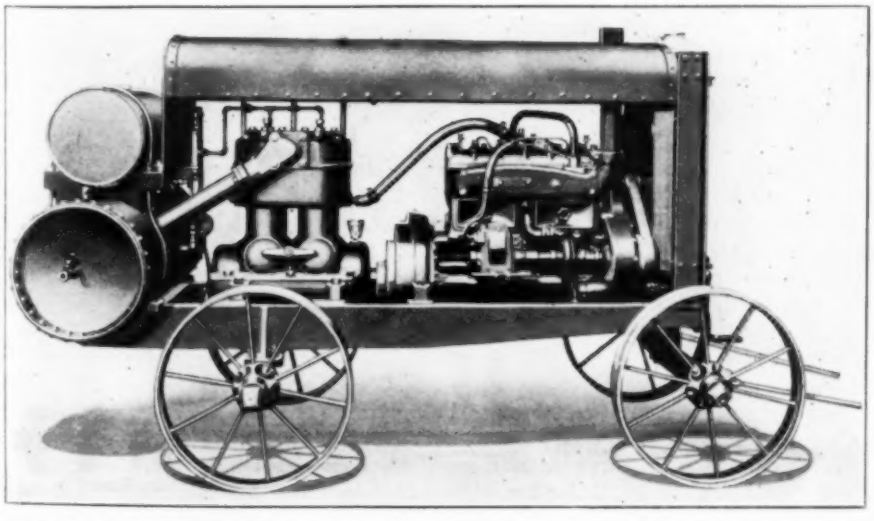


PORTABLE AIR-OPERATED GRINDER WEIGHS 12 POUNDS

Transport Compressor About the Plant

A small portable air compressor of modern design has been developed by the Ingersoll-Rand Co., New York. This compressor has a piston displacement of 60 cubic feet per minute and is built along the lines of the larger portables manufactured by this company. Many of the features of the larger units are retained, such as duplex, vertical compressor, direct connected to a four-cylinder, four-cycle, tractor type gasoline engine; enclosed construction, circulating water cooling system for engine and compressor with sectionalized radiator, fan and pump; compressor regulator and engine control for reducing speed during unloading periods; and one piece cast iron frame sheet steel roof and removable side doors.

The compressor may be furnished in a variety of mountings, namely steel wheels and axles, wooden artillery wheels with solid rubber tires and steel axles, on a Ford truck, and on skids for mounting in a car or truck. The unit equipped with steel wheels is shown in the accompanying illustration. This compressor also is available with electric motor drive.



PORTABLE AIR COMPRESSOR HAS A CAPACITY OF 60 CUBIC FEET PER MINUTE

Equipment Buying Slackens

General Decline Noted in Volume of Business as Users Wait for Improvement in Trade Conditions—Inquiries Fall Off Sharply—Manufacturers Are Not Discouraged

SLIGHT but steady increases in the volume of foundry equipment business noted since the first of the year, at present seem to be halted. Only scattered sales have been made during the past two weeks, and at the same time inquiries are reported to have fallen off. However, makers of equipment are not discouraged over the outlook. The W. W. Sly Mfg. Co., Cleveland, has sold sand blast equipment and dust arrester installations to the Ohio Brass Co., Mansfield, O., and the Fox Furnace Co., Elyria, O. The Sly company also sold sand blast equipment to the Commercial Steel Casting Co., Marion, O. The Pangborn Corp., Hagerstown, Md., has sold tumbling mill equipment to the Superior Gas Engine Co., Springfield, O., and the National Malleable & Steel Castings Co., Toledo, O., the latter company purchasing 28 mills. The Ross-Meehan Foundries, Chattanooga, Tenn., has purchased a 3-ton electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh. The Mayor Fuel Saving Furnace Co., Cleveland, has installed equipment at Fulton Foundry & Machine Co., Cleveland, two units at the new foundry of the Bowler Foundry Co., Cleveland, one at the plant of the Farrel Foundry & Machine Co., Ansonia, Conn., one at the Framingham Foundries, Inc., Framingham, Mass., and one each at the plant of the Eastern Steel Casting Co., Newark, N. J., and the Adamson Machine Co., Akron, O. The H. K. Ferguson Co., Cleveland, is preparing plans for the foundry of the Continental Gin Co., Birmingham, Ala., the equipment for which has not been purchased. The Fairfax Iron & Steel Co., Kansas City, Kan., is in the market for one 3-ton electric melting furnace.

Little Improvement in East

TRADING in the eastern foundry equipment field is showing little improvement. In the opinion of some sellers, business is the slowest so far this year. New foundry projects are virtually nil, while extensions are noted in only a few cases. As a result, few sizable lists are active and the scattered buying is largely for replacement purposes. However, one seller of late has noted an improvement in demand for sand cutters and dust arresters, attributing it in part to the greatly curtailed operations at many of the foundries, which affords an opportunity for the operators to make necessary changes and alterations. A leading crane award in the eastern foundry field involves six 3-ton handpower cranes for the Putnam Foundry & Machine Co., Putnam, Conn. This business went to the Whiting Corp., Harvey, Ill. Another crane award calls for a revolving gantry crane, equipped with a ¾-cubic yard bucket, for the Columbia Machine Works & Malleable Iron Co., Brooklyn, this business being reported as going to Edgar E. Brosius, Pittsburgh. The Pangborn Corp., Hagerstown, Md., has sold sand blast and dust arrester equipment to the New York Central Railroad Co., New York, and the Bierman-Everett Foundry Co., Irvington, N. J. Demand for flasks and other supplies is being maintained at a fair rate. Prices on virtually all lines of foundry equipment are unchanged. One notable exception, however, is to be found in cranes and other conveying machinery, the sharp competition in this field bringing out substantial concessions. Prices on cranes are now generally conceded to be the lowest in several months. With little pending in the way of new projects and the general business situation apparently promising little improvement until at least after the political convention, foundry equipment sellers expect to see little material change over the next several weeks. Practically all sellers, however, are looking forward to a fairly brisk demand this fall.

Buying Continues Slack

PRESENT equipment in foundries in the Pittsburgh area is not fully engaged except in a few instances, and for the most part foundry operators find it unnecessary to augment their layouts. Small supplies are bought as needed, such as are flasks, riddles and kindred equipment, but the buying of larger machinery will probably be deferred until the foundries become more active. Only a few orders for molding machines have been placed in the last two weeks, and a comparatively small number of inquiries are before builders here. One comes from the acting commercial attache, H. Lawrence Groves, Obecni Dum, Prague, Czecho-Slovakia, which calls for molding machines and other equipment for an iron foundry at Prague. A few foundries making railroad car and locomotive castings likewise have inquiries pending. Sand blast rooms with dust arrester equipment has been sold to the Kensington Davis Corp., Buffalo, by the W. W. Sly Mfg. Co., Cleveland. The latter company also sold tilted blast mills of the positive pressure type to the malleable foundry of the American Chain Co., Inc., York, Pa., and tumbling mill equipment to the General Electric Co., Erie, Pa. A local dealer has sold a small cupola and core oven for the foundry at the New York state reformatory, Elmira, N. Y. The Franklin Valveless Engine Co., Franklin, Pa., will rebuild its foundry, necessitating the purchase of some replacement equipment. This foundry was badly damaged by fire recently. The Standard Sanitary Mfg. Co., Pittsburgh, probably will purchase considerable equipment for its new foundry addition at Louisville, Ky., for which the general contract has been let, as well as for its addition at Tiffan, O., which will cost $45,000, including equipment. The largest crane order placed recently is that of the Westinghouse Electric & Mfg. Co. for its Sharon, Pa., plant. That company bought three 15-ton cranes with 56-foot span and one 15-ton crane with 75-foot span from the Alliance Machine Co., Alliance, O. Its order for a 30-ton crane with 80-foot span went to the Cleveland Crane & Engineering Works, Wickliffe, O.,

while the Morgan Engineering Co., Alliance, O., received the award of the 75-ton and the 50-ton cranes with 80-foot span. The largest crane inquiry is that of the Westinghouse Airbrake Co., Wilmerding, Pa., for five hoists and five cranes, 3 to 5-ton capacity. This latter order probably will be placed within the next week. The Dilts Machine Works, Fulton, N. Y., purchased a 2-ton single I-beam crane with 22-foot span from the Shepard Electric Crane & Hoist Co., Montour Falls, N. J.

Little Business in New England

DEMAND for foundry equipment throughout New England is flat. Foundry production has dropped off slightly since the first of the month and this has spread a new note of caution throughout the market. Inquiry some weeks ago pointed to fair buying of labor-saving equipment, but now even this hope has disappeared. Some encouragement is found in reports from foundry supply companies who recently have experienced an exceptional volume of business. A manufacturer of flasks is operating at capacity and is unable to keep up with orders. Several New England foundries are going ahead with extensions and alterations and considerable equipment will be required in this connection. Current sales, however, are almost negligible. The Saco-Lowell Shops, Biddeford, Me., bought two 5-ton cranes. The Royer Foundry & Machine Co., Wilkes-Barre, Pa., has sold a sand separator to a user in this district. The Connecticut Foundry Co, Rocky Hill, Conn, has purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland.

Inquiries Light in West

CHICAGO district manufacturers of foundry equipment continue to note a decline in inquiries. Greater resistance is being met in closing inquiries already out. In general, foundrymen are deferring buying until business improves. Pig iron sellers in the Chicago district look for increased buying of iron from now on, and this may be the forerunner of general improvement. Sand mixers made by the National Engineering Co., Chicago, have been placed recently in the foundries of the Bucyrus Co., South Milwaukee, Wis., J. I. Case Threshing Machine Works, Racine, Wis., and the Valley Mold & Iron Corp., Sharpsburg, Pa. The W. W. Sly Mfg. Co., Cleveland, has sold a tilted blast mill of the positive pressure type to the Maytag Co., Newton, Ia. Sand blast equipment has been purchased by the Doran Brass Foundry Co., Seattle, the West Michigan Steel Casting Co., Muskegon, Mich., and the Michigan Motor Casting Co., of the Buick Motor Co., Flint, Mich., from the Pangborn Corp., Hagerstown, Md. The Nevada Consolidated Copper Co., McGill, Nev., has purchased a 1½-ton electric furnace for melting gray iron and steel from the Pittsburgh Electric Furnace Corp., Pittsburgh.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Launchly Foundry & Machine Co., Jackson, Miss., has increased its capital stock from $50,000 to $75,000.

Capolen Steel Co., Ogdensburg, N. Y., will start work shortly on an 85 x 352-foot foundry to cost approximately $75,000.

Erie Malleable Iron Co., Twelfth and Cherry streets, Erie, Pa., has been issued permit to construct plant additions.

The Gray Foundry, Inc., Poultney, Vt., with offices at 5 Nassau street, New York, is in the market for a ¼-yard electric shovel.

A modern foundry and machine shop with capacity for heavy castings is planned for establishment soon at Craig, Colo.

Linde Air Products Co., New York, plans constructing large plant of reinforced concrete, steel and brick at Portsmouth, O.

United States Chain & Forging Co., York, Pa., has awarded contract to Fort Pitt Bridge Works for erecting plant addition.

Rockford Brass Works, Rockford, Ill., has awarded contracts for constructing foundry and plant addition. The company operates brass and aluminum foundries.

Unique Brass Foundry, 123 Military street, Detroit, has awarded contracts for constructing 1-story, 50 x 50-foot drop forge building. The company operates a brass foundry.

Advance Foundry & Machine Co., Dover, N. J., has been incorporated with $150,000 capital by Charles Peterman, Charles S. Moore and August Besha.

Pacific Foundry Co., 1113 St. Paul avenue, Tacoma, Wash., recently damaged by fire, purchased a site on East D street where it will construct a plant. *Noted May* 15.

The General Foundry & Machine Co., McDonald, Pa., Raphael Staveralla, 710 Peoples Bank building, Pittsburgh, in charge, is taking bids for a 1-story 60 x 75-foot brick construction brass foundry. A. F. Nordenskgold, 510 Peoples Bank building, Pittsburgh, is mechanical engineer.

Pekor Iron Works, Columbus, Ga., operator of gray iron, brass and aluminum foundries, has started constructing machine shop and office building.

Christiana Machine Co., Christiana, Pa., plans construction of 1-story, 60 x 1000-foot shop addition. W. D. Grant is superintendent. The company operates a gray iron foundry.

William T. Bate & Son, Conshohocken, Pa., operator of gray iron and brass foundries and boiler works, was damaged by fire in its plant at Elm and Harry streets. Little loss was sustained.

The American Boiler & Foundry Co., Milan, Mich., recently has been incorporated for $50,000 and plans constructing foundry for production of iron castings. E. L. Watson is president and general manager.

Federal Shipbuilding Co., Kearny, N. J., will start rebuilding portions of plant recently damaged by fire. The company operates brass and gray iron foundries and is a subsidiary of the United States Steel Corp.

The Buffalo Brake Beam Co., Buffalo, N. Y., plans constructing brick and steel plant at Lackawanna, N. Y., to be used as a forge shop. The forge plant is part of extensive expansion program under way by the company.

Ward Railway Equipment Co., Lima, O., recently incorporated, will be in the market shortly for general foundry equipment for gray iron and semisteel purposes. J. T. Ward is president. *Noted April* 1.

Pawling & Harnischfeger Co., Milwaukee, builder of electric traveling cranes, machine tools, etc., is making extensive alterations and additions to its foundry recently acquired from the Hercules Steel Casting Co. at 871 Robinson avenue, that city. O. P. Wills is general plant engineer. The foundry is used for steel castings.

The Pacific Sanitary Mfg. Co., 67 New Montgomery street, San Francisco, operator of a gray iron foundry, has purchased property adjoining its plant at San Pablo, where it plans extensions.

The Becker Mfg. Co., Two Rivers, Wis., will be in the market shortly for furnaces, etc., for its proposed foundry to be used for manufacture of castings and machined parts. Frank Becker is president. *Noted May* 15.

Tampa Shipbuilding & Engineering Co., Tampa, Fla., operator of gray iron, brass and aluminum foundries, plans establishing a plant at Tarrant City, Ala., for the manufacture of tractors. Ernest Kreher is president.

The Eagle Iron Works, Talladega, Ala., recently incorporated, has purchased machinery for its machine shop and foundry which it has bought on North street. J. S. Hanson is president and general manager.

American Sanitary Mfg. Co., Abington, Ill., has commissioned Lockwood, Greene & Co., Boston, engineers, to design and supervise constructing addition to its plant. The American company operates brass and aluminum foundries.

The Standard Sanitary Mfg. Co., Bessemer building, Pittsburgh, has let contracts for constructing 6-story, 80 x 200-foot warehouse and plant on C street at Boston. French & Hubbard, 219 South street, Boston, are engineers.

The Boynton Furnace Co., 230 Pacific avenue, Jersey City, N. J., has awarded contracts for constructing 1-story foundry to cost about $150,000. The company operates a gray iron foundry.

Agricola Pipe Co., Gadsden, Ala., operator of a gray iron foundry, plans constructing shed 60 x 125 feet, pattern shop 30 x 90 feet. In-

stallation of new equipment is planned to supplement that now in operation and to make the plant more modern.

The Greenville Steel & Foundry Co., Greenville, S. C., recently incorporated, has plans for remodeling and installing machinery in plant recently leased. Edward McCrady is president of the company and Daniel H. Wallace, Jr., secretary. *Noted June 2.*

William Sellers & Co., Inc., Sixteenth and Hamilton streets, Philadelphia, has awarded contracts for constructing plant addition to Fred A. Havens, 845 North Sixteenth street. The sellers company operates gray iron and brass foundries and manufactures machine tools.

J. E. Lonergan Co., 211 Race street, Philadelphia, operator of a brass foundry and manufacturer of steam specialties, has let contract to William Steele & Sons Co., 219 North Broad street, for plant to replace that recently damaged by fire. *Noted May 1.*

The Colby Management Corp., Pacific Electric building, Los Angeles, has awarded Union Iron Works, that city, contracts for constructing foundry, machine shop and assembling plant, each building to be 100 x 300 feet, at Monrovia Cal.

The Waterbury Farrel Foundry & Machine Co., 425 Bank street, Waterbury, Conn., is planning construction of 60 x 100-foot addition to plant including charging department. F. A. Webster, 51 West Main street, is architect. The company operates gray iron and brass foundries.

The Crane Co., 826 South Michigan avenue, Chicago, manufacturer of valves, etc., and operator of gray iron, steel, malleable and brass foundries, plans constructing 1-story, 68 x 148-foot brick warehouse and plant on Broad street. W. Jerome Clarke, 1518 Keystone avenue, Chicago, is architect.

Rundle Mfg. Co., Twenty-seventh avenue and Wahl street, Milwaukee, has retained Cahill & Douglas, 217 West Water street, consulting engineers, to plant installation of oil burning equipment in its plant. Oil storage tanks of 25,000-gallon capacity are planned. The Rundle company operates gray iron and brass foundries and manufactures bath tubs, brass goods and general plumbing materials.

The Crane Co., Chicago, now located at 64 Mechanic street, Irvington, N. J., has bought property at 432-6 Mulberry street, in the latter city, from the Manufacturer's Can Co., Harrison, N. J. A 3-story plant will be constructed of reinforced concrete and brick. It is to be ready for occupancy Jan. 1, 1925. The Crane Co. operates gray iron, malleable, steel and brass foundries.

The C. & G. Foundry & Pattern Works, Indianapolis, Ind., will not buy additional equipment at present in connection with the consolidation of its pattern shop and foundry departments. At a future date it will be in the market for equipment to increase foundry production and to handle all classes of brass, bronze and aluminum castings. Extensions are planned for the near future. Charles J. Gisler is president and Fred W. Crider, secretary and treasurer. *Noted May 15.*

New Trade Publications

VIBRATORS—Advantages of an unbalanced type of vibrator in which the impact at one end is heavier than at the other are described in a circular by the Hanna Engineering Co., Chicago. Other details of the vibrator are also described.

ELECTRIC MOTORS—Alternating and direct current motors, motor generator sets and electroplating generators manufactured by the Chandeysson Electric Co., St. Louis, are described and specifications outlined in a series of bulletins which present details of construction and operation.

EXHAUST FANS—Direct motor and belt drive exhaust fans are described in a folder published by the Northern Blower Co., Cleveland. In addition to views of the two types and the various parts of the blower, a view of the system installed in a woodshop also is given.

METAL SPRAYER—Apparatus for simultaneously melting, atomizing and applying to any surface, coatings of commercial metals is described in a pamphlet published by the Metals Coating Co. of America, Philadelphia. Apparatus for spraying the metal both in the field or in the shop is described and illustrated.

TUMBLING MILL—The Royersford Foundry & Machine Co., Inc., Royersford, Pa., has issued a 4-page pamphlet illustrating and describing an exhaust type tumbling mill to which roller bearings recently have been added. The various parts that go to make up the mill are thoroughly described, and the specifications of the different types are given.

SAND CUTTERS—The American Foundry Equipment Co., New York, has issued a folder describing various types of machines for cutting sand. This company makes three types of machines in various sizes to suit the particular foundry requirements. The folder is well illustrated with views of machines in operation.

STEAM ENGINES—The Mesta Machine Co., Pittsburgh, has issued a bulletin describing an engine which is particularly adapted to rolling mill service. Views of several installations are included as is a steam consumption chart.

CORE MACHINE—Two types of core machines are illustrated and described in a pamphlet of the Skeppstedt-Erickson Co., Moline, Ill. The small type machine is built for light work while the larger machine is built for work having a large run.

ENGINES AND GENERATORS—Denominating it an instruction book, Engberg's Electric & Mechanical Works, St. Joseph, Mich., has published a book of 32 pages devoted to detailed descriptions and drawings of the engines and generators manufactured by the company. Halftones and blue prints convey full details of the machines and their parts, while the text describes methods of operation and care.

HEATING SYSTEMS—A system for utilizing heat in industrial buildings is described in a booklet entitled "Improved Heating for Industrial Buildings at Minimum Cost" which has been issued by the Dwyer Equipment Co., Chicago. In addition to describing the principles of good practice in industrial heating, views of a large number of installations of the system made by that company are shown.

GUARDS—Safety first guards for machinery, railings, enclosures, fire escapes, cranes, and windows are described and thoroughly illustrated in a catalog published by the Fred J. Meyers Mfg. Co., Hamilton, O. The company also makes a variety of iron and bronze work including signs, iron doors, iron gates, iron stairs, fencing, wire and metal baskets, etc., which are described.

WELDING AND CUTTING EQUIPMENT—Products of Smith's Inventions, Inc., Minneapolis, as applied to welding and cutting, are set forth in a folder which is intended as a ready reference for those in need of such equipment. Complete outfits and necessary parts are illustrated and described and new uses to which they can be put are suggested.

HOISTS AND CRANES—Whatever information may be desired in relation to its hoists, chain blocks and cranes seems likely to be found in catalog No. 30 by the Reading Chain & Block Corp., Reading, Pa. In it are illustrated the full line of chain and electric hoists, jib cranes, traveling cranes, I-beam trolleys and their applications. Tables of dimensions and other data are presented. The book is well illustrated.

PNEUMATIC TOOLS—The Independent Tool Co., Chicago, has published a 42-page booklet describing the various kinds of pneumatic tools made by that company. Among the products described are portable grinders, motor hoists, chipping, calking and flue beading hammers, foundry hammers, scalers, light riveting hammers, long stroke riveting hammers, core busters, sand rammers, and various types of air drills. The booklet is well illustrated.

ELECTRIC FURNACES—Annealing of castings and wire, heat treating, calorizing, sherardizing and other processes using electric furnaces are shown in a bulletin recently issued by the General Electric Co., Schenectady, N. Y. The publication is mostly pictorial in content, illustrating the application of this type of heat to the various operations in plants of that company. Details as to heat, dimensions and the function of each installation shown are given.

STEAM SHOVEL—Strength, accessibility and convertibility are claimed as features of the steam shovel described in a booklet by the McMyler-Interstate Co., Cleveland. Every part of the device is described in detail with illustrations furnishing intimate insight into construcion and operation. Alternative equipment allows conversion into a crane with 40-foot boom for using clamshell bucket, drag line bucket and magnet. Other equipment manufactured by the company also is illustrated.

BLAST GATE—A wide variety of uses for its air-tight blast gates is shown in a bulletin recently issued by the W. S. Rockwell Co., New York. Not only in control of compressed air is the device said to be efficient, but also in lines carrying powdered coal, starch, paint and such materials. Illustrations show the range of sizes and construction of the gates and the text gives its advantages for various uses. A table of dimensions shows types needed for various sizes of line pipe.

AIR COMPRESSORS—The Sullivan Machinery Co., Chicago, has issued two bulletins, one describing angle compound power driven air compressors and the other the belt driven air compressor. These compressors are designed for service in mines, quarries and on construction enterprises and in foundries, factories, mills, railroad shops, etc. The bulletins are well illustrated with views of the various types of compressors described and also reproductions of photographs showing actual installations.

INDUSTRIAL LUBRICATION—In a booklet by the Waverly Oil Works Co., Pittsburgh, lubrication charts and data on the proper means of lubrication of various machinery give to anyone interested in lubrication an excellent understanding of what may be accomplished by choosing the proper oil or grease for the purpose intended. A chapter on the principles of lubrication offers much information to aid in working out problems that arise in deciding what lubricant will give best service at a representative cost.